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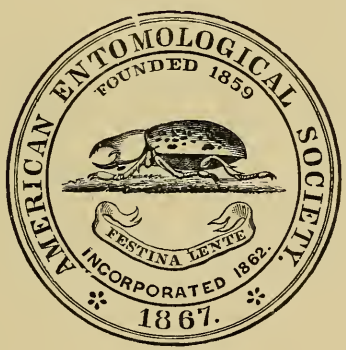

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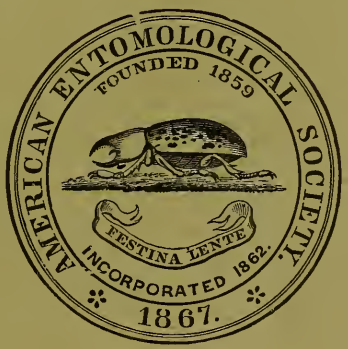

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VOLUME XXXVIII.

THE ICHNEUMON FLIES OF AMERICA BELONGING TO THE TRIBE OPHIONINI.

BY CHARLES W. HOOKER, PH.D.,

Of the Massachusetts Agricultural College, Amherst, Mass.

INTRODUCTION.

This paper forms the major part of a thesis for the degree of doctor of philosophy at the Massachusetts Agricultural College, where it has been prepared under the supervision of Prof. Charles H. and Dr. Henry T. Fernald. To both, for the many ways in which they have guided and encouraged me in the work, I give my sincere thanks.

The investigations contained in this paper are based upon the extensive collections of the United States National Museum and the American Entomological Society in Philadelphia. In addition to these the collections of the New York State Museum, the American Museum of Natural History, the Boston Society of Natural History, the Brooklyn Museum, the Leland Stanford, Jr. University; the New Hampshire, Minnesota, Montana and Colorado State Agricultural Colleges; the North Carolina Department of Agriculture, the Pennsylvania Department of Agriculture, Division of Zoology, the Boll Weevil Laboratory of the Bureau of Entomology, U. S. Department of Agriculture, at Dallas, Texas, and other smaller collections have been carefully examined. All but four of the types existing in America, so far as known, have been examined and descriptions prepared di-

rectly from them, modified or added to by comparing with other specimens and the original descriptions. During the time that I have carried on this work material has been loaned, through Dr. H. T. Fernald, and assistance given by many persons. I am greatly indebted to Dr. L. O. Howard of the U. S. Department of Agriculture and Dr. Henry Skinner of the American Entomological Society for the loan of material; to Messrs. J. C. Crawford and E. T. Cresson, Jr., for aid at the museums with which they are connected; to the Committee of Nomenclature of the Entomological Society of America, for rulings on numerous problems; to Mrs. A. K. Dimmock, for information as to the habits of *Thyreodon morio*, with specimens of its cocoons and of *Encyrtus thyreodontis*, its parasite; to Messrs. C. W. Johnson, E. D. Sanderson, William Beutenmüller, W. D. Hunter and others for the loan of material; to Messrs. C. O. Waterhouse, Geoffrey Meade-Waldo and A. G. B. Bouquet for information in regard to types in the British Museum; and to Mr. W. T. Horne with regard to types in Havana, Cuba.

This division of the subfamily was first proposed by Förster in 1868 as the Family Ophionoidæ and first given tribal rank by Ashmead in 1894. Most of the work on this group has been done on European species by Brullé, Gravenhorst, Förster, Vollenhoven, Thomson, Taschenberg and Szepligeti, but Brullé, Taschenberg and Szepligeti have also described many American species. Among American workers, Cresson, Norton and Ashmead have described numerous species, but none of these have treated the tribe as a whole. Felt's paper is the best for the North American species, but only covers the more common species of *Ophion*, *Eremotylus* and *Enicospilus*. The largest American collections in this tribe are probably at the United States National Museum and the American Entomological Society in Philadelphia, but the Massachusetts Agricultural College has a good representation, and the British Museum has considerable unworked material. The largest number of types was found in the collection of the American Entomological Society.

Some European writers have added much confusion to our knowledge of this tribe by describing numerous new species from America without a proper knowledge of those already described. Many of these descriptions are too brief to make identification possible, and others are clearly synonyms.

Mr. H. M. Russell began work on this tribe, and in 1906 offered a senior thesis on the genera *Agathophiona*, *Enicospilus*, *Eremotylus*, *Ophion*, *Ophiopterus* and *Thyreodon* as represented north of the Isthmus of Panama. Upon his acceptance of a position with the Bureau of Entomology at Washington, his material was placed in my hands, and the bibliographies he had prepared and some other portions proved very useful. As he had studied almost none of the types, however, and had not completed studies on any of the species, it became necessary to repeat all he had done, and therefore I must assume responsibility for any errors or deficiencies discovered in this paper.

Table of Tribes.*

1. Second recurrent nervure joining the cubitus *behind* the transverse cubitus, or interstitial with it; middle tibiæ always with *two* apical spurs.....Other (Non-American) Tribes.
   Second recurrent nervure joining the cubitus *before* the transverse cubitus, or it is entirely wanting (*Pharsalia* Cr.); if it joins the cubitus *behind* the transverse cubitus then the middle tibiæ have but a *single* apical spur.....2.
2. Middle tibiæ with *two* apical spurs; second recurrent nervure joining the cubitus *before* the transverse median nervure.....3.
   Middle tibiæ with only one apical spur; second recurrent nervure joining the cubitus *behind* the transverse cubitus or entirely wanting .....Tribe Nototrachini.
3. Antennæ *short*, *clavate;* mesosternum beneath flat, mesonotum without parapsidal furrows.
   (Non-American) Tribe Hellwigiini.
   Antennæ *long*, *subsetaceous* (filiform); mesonotum usually with distinct parapsidal furrows.....Tribe Ophionini.

* It has not seemed necessary to include tables from the Family Ichneumonidæ since any one using this paper will undoubtedly be able to recognize Ophionini, but such if desired can be found in Proc. U. S. Nat. Mus., No. 1206, pp. 10, 85 (Vol. 23, 1901), 1900. The table of tribes given here is that of Ashmead, slightly rearranged and modified.

Tribe Ophionini Först.

Ophionoidæ *Förster*, Verh. Nat. Ver. Pr. Rheinl., 25, pp. 141, 149; Fam. 7.....1868.
? Ophioninæ *Cameron*, Biol. Centr. Amer., Hym., I, pp. 288.....1886.
Ophionidæ *Thomson*, Opusc. Ent., XI, p. 1047, Fam.....1887.
Ophioninæ *Cresson*, Syn. Hym. N. A., p. 43, Subfam.....1887.
Ophionini *Ashmead*, Proc. Ent. Soc. Wash., III, p. 277, Tribe VII.....1894.
" *Davis*, Trans. Amer. Ent. Soc., XXIV, p. 195, Tribe .1897.
" *Ashmead*, Trans. Ent. Soc. Lond., p. 354, Tribe II.....1900.
" " Smith's Ins. N. J., p. 580, Tribe II.....1900.
" " Proc. U. S. Nat. Mus., No. 1206, pp. 84, 86, Tribe II (Vol. 23). Classification of Ichneumon Flies.....1900.
" " Faun. Hawaiensis, Vol. I, part III, p. 341, Tribe II.....1901.
Ophioninæ *Dalla Torre*, Cat. Hym., III, p. 179, Subfam., XI.....1901.
Ophionini *Felt*, N. Y. State Mus., Bull. 76 (19th Ent. Rept.), pp. 79–125.....1903.
Ophioninæ *Szepligeti*, Gen. Ins., Hym. 34me Fas., pp. 2, 20, Subfam. V.....1905.
Ophionini *Schmiedeknecht*, Opusc. Ichn., XVIII, p. 1416, Tribe II..1908.

Median tibiæ with two apical spurs, wings without areolet, discocubital cell receiving both recurrent nervures, antennæ long, filiform.

Type of tribe.—*Ophion* Fabr.

To this tribe belong the true Ophions—insects belonging to the Genus *Ophion* and its allies, which may be distinguished from all the others in the subfamily, except the Hellwigiini, by their venation, the discocubital cell receiving *both* recurrent veins. The Ophionini are however readily separated from the Hellwigiini by the long filiform antennæ, short and clavate in the latter, and as the Hellwigiini are so far as known entirely European there need be no confusion. These characters, with the usually strongly compressed and falcate abdomen, readily separate the members of this tribe. This division of the subfamily was first proposed by Förster in 1868 as the Family Ophioninæ, and first given tribal rank by Ashmead in 1894, since which time it has been generally recognized.

Distribution.

The Tribe Ophionini comprises about thirty genera of which only eight have been found in America. Of these *Ophion*, *Enicospilus* and *Eremotylus* have a world-wide distribution, but among the others, most of the species are American; members of the tribe range in America from Sitka, Alaska, to Chubut Territory (Patagonia), Argentina, including the West Indies. Most of the species are tropical or subtropical, but some range into the Boreal Zone; *Ophion bilineatus* apparently ranges from Alaska to Patagonia, *Enicospilus purgatus* from Alaska to Chili, and *Thyreodon laticinctus* from Central Mexico to Chili.

Table of Genera.

1. Discocubital vein *angularly broken* and appendiculate.....2.
   Discocubital vein *not angularly broken*, straight or bent.....3.
2. Labium abnormally *lengthened*, nervellus broken slightly above the middle, nervulus postfurcal to interstitial.
   Agathophiona West.
   Labium *normal*, not lengthened, nervellus broken at or below the middle, nervulus antefurcal to interstitial.....**Ophion** Fabr.
3. Claws *simple*, not pectinate.....**Retanisia** Cam.
   Claws *pectinate*.....4.
4. Discocubital cell *with* one or more maculæ...**Enicospilus** Steph.
   Discocubital cell *without* maculæ.....5.
5. Nervellus *straight*, not broken.....**Ophiopterus** Br.
   Nervellus *angularly broken*.....6.
6. Nervellus broken *above* the middle.....7.
   Nervellus broken *at* or *below* the middle.....9.
7. Ocelli *large*, close to each other and to the tops of the eyes.
   Athyreodon Ashm.
   Ocelli *small*, well separated from each other, and from the tops of the eyes.....8.
8. Anterior wing *with* stigma.....**Ophion** Fabr.
   Anterior wing *without* stigma.....**Thyreodon** Br.
9. Radial vein with the basal half *slender*, not thickened.
   Ophion Fabr.
   Radial vein with basal half *thickened*.....10.
10. Base of radial vein straight.....**Ophiomorpha** Szep.
    Base of radial vein bent.....**Eremotylus** Först.

External Anatomy.

Head (Pl. I, fig. 4).—The hypognathous head is large, viewed from in front usually as broad or slightly broader than high, rarely higher than broad; when viewed from above oblique in outline and somewhat hollowed out behind. The compound eyes are usually large, extending almost to the base of the mandibles; rarely small, distant from the base of the mandibles and more narrow; the anterior margin is usually emarginate opposite the antennal fossæ, but is sometimes only slightly so, being almost straight. Each eye is sometimes surrounded by a more or less distinct crenulated carina.

The three usually prominent ocelli are located on the vertex between the tops of the eyes, in the form of a triangle, which varies somewhat in shape and size. The size and distance of the ocelli from the tops of the eyes vary in different genera—and somewhat in different species—the latter from twice the diameter of the ocellus in *Thyreodon*, to little or practically nothing in *Athyreodon*, with the other genera intermediate but nearer *Athyreodon*. A few species of *Ophion* have, however, small ocelli and some species of *Thyreodon*, especially *Thyreodon spectabilis*, indicate that the size is not well fixed. I have seen specimens of this species which apparently bridge the distance between the large and small ocelli of *Athyreodon* and *Thyreodon*.

The vertex is not distinctly separated from the occiput, except in *Ophion costale*, where a distinct carina runs from the tops of the eyes to the posterior ocelli, though similar but indistinct carinæ sometimes occur in other members of the tribe.

The vertex is usually smooth, sometimes rugose, aud often with a median carina running from the anterior ocellus to or below the antennal fossæ; these, located slightly above the middle of and not far from the eyes, vary somewhat in size and depth and are sometimes inclosed by a distinct carina. The long filiform antennæ are divided into a scape, pedicel and flagellum of about 61 segments, the number varying somewhat. The frons, which is continuous with the vertex, extends to or below the base of the eyes. It usually

bears no distinctive marks, but more or less evident tubercles are sometimes present below or between the antennal fossæ. The clypeus is not separated from the frons above but at its outer margin is a more or less distinct fovea, deep and oval or sometimes shallow and more elongate, with a furrow extending from it to the base of the mandibles; the anterior margin of the clypeus is rounded, or somewhat pointed in the middle. The mouth parts vary but little in this group so far as as I have seen, and are not of value in determining species; the only difference is a slight variation in size in different species. The mandibles are long, slightly curved, bidentate and tipped with, or in some cases entirely, black; one of the teeth being somewhat longer.

Behind, the head is somewhat hollowed out.

The *thorax* is smooth or more or less distinctly punctate and the thoracic sutures are often keeled or crenulate, especially between the pleuræ.

Prothorax (Pl. I, figs. 1, 3).—The prothorax is divided into two parts: the slender collar which articulates above with the head, and bears the anterior legs below, and behind this on each side a triangular shaped piece extending back to the insertion of the anterior wings. The collar fits into a sort of socket in the front of the second part and mesothorax and is hardly visible from the side. Beneath, a weak median groove runs from the articulation with the head to between the insertion of the coxæ, dividing the collar into lateral lobes.

Mesothorax.—The mesonotum is a broad plate lying between the anterior wings, prothorax and the metathorax with its edge frequently carinate. It is somewhat convex, usually with more or less distinct parapsidal furrows running from the anterior border to and converging on the posterior border. They are sometimes distinct only in front, sometimes broad and crenulated or with one or more carinæ, and sometimes join at or before the posterior border.

Behind the mesonotum but separated from it by a deep, more or less distinct furrow lies the scutellum. Its center is convex and circular or somewhat elongate, with more or

less distinct lateral carinæ which usually connect it with the mesonotum in front and sometimes unite behind. In some species these carinæ are high and the front of the scutellum appears deeply excavated, in others they are indistinct.

The broad mesothoracic pleura lies below the anterior wing, its posterior edge being frequently crenulate or keeled, the suture running obliquely from the base of the anterior wing to the posterior edge of the mesocoxa, where a small projection articulates with a similar one from the metapleura and apparently serves to prevent too great flexure of this segment of the leg. There are no sutures or other marks between the pleura and sternum, and I have observed no characters on the latter which are useful in distinguishing species.

Metathorax.—The metathorax proper is a narrow band which lies directly behind the mesothorax, bearing the posterior wings above and the posterior legs below. It has no distinctive characters and is so closely joined to the median segment—which I have everywhere referred to as the metathorax—that I have not mentioned it in descriptions. It consists of a narrow dorsal band, composed of the pleura and postscutellum, partly separated by the insertion of the posterior wings, and a narrow ventral section—epimeron—extending back below and closely attached to the median segment and bearing the posterior legs behind.

Median segment.—The median segment, or, as I have everywhere called it, the metathorax,* is rounded, sometimes with the back part of the metathorax proper almost globular, but generally more or less flattened behind and sloping to the insertion of the abdomen. In the Genus *Ophiopterus*, however, it is produced behind into a distinct neck. The surface is smooth, more or less strongly, finely or coarsely rugose, rugose-striate or reticulate or rarely almost granulose. A more or less distinct median longitudinal furrow frequently runs from the insertion of the abdomen to the posterior edge of the metathorax proper, but in some species this is wanting.

* In all descriptions of American species of this tribe, it has been referred to as the metathorax and a change would lead to confusion.

Wings (Pl. II, fig. 8).—The wings are quite large, usually hyaline and often irridescent, though frequently, especially in *Thyreodon* and *Athyreodon*, more or less colored with fuscus, fulvus or fuliginous, sometimes with a violet reflection, and in some species entirely black or cyaneous. The surface is sparsely covered with very fine, short hairs, but a glabrous area frequently occurs in the discocubital cell. It has seemed best to follow in this paper the nomenclature of veins and cells used by Cresson and others, and this is given on Plate II, figure 8.

Anterior wing.—A well developed stigma is present in most members of this tribe, but in *Thyreodon* and *Athyreodon* it is lacking. The discocubital cell receives both recurrent veins—which vary in length in different species—and in the Genus *Enicospilus* contains one to three yellow chitinous thickenings called maculæ. The number, size and shape of these maculæ seem constant in some species but in others variation is evident. The discocubital vein is angularly broken, angularly bent or arcuate, sometimes slightly sinuous, and this difference in shape has been given generic value. In *Agathophiona*, and *Ophion* it is usually angularly broken and appendiculate with a short stub of a vein—appendix—extending from the point of the angular out into the discocubital cell—but in some species only angularly bent or arcuate and without an appendix. In the other genera it is arcuate or slightly sinuous. The radial vein is slender throughout and straight, except in the Genera *Eremotylus* *Enicospilus* and *Ophiomorpha* where it is thickened and more or less bent, or in some species angularly broken near the stigma. This is, I believe, the older condition showing where the second transverse cubital vein originated. The place of connection of the transverse median vein, or, as I have called it for brevity, *nervulus* (thereby following European writers), and the median vein, varies in different species; in some it meets the end of the basal vein—when it is called *interstitial* —*or* is nearer the body—*prefurcal* or *antefurcal*, in these cases uniting with the discoidal vein (which is Cresson's name for

the median beyond its union with the basal vein). In others it is *interstitial*, or nearer the apex of the wing—*postfurcal*. Transparent spots, called bullas, occur in the discocubital and second recurrent veins. The discoidal and cubital cells are confluent, and as there is no areolet this portion becomes a sort of appendix. The third discoidal cell is in most Ophions short and thick, but in *O. costale*, as in the other genera, it is long and narrow.

Posterior wing.—The only important character in the posterior wing is the shape of the transvere median vein, or, as I have called it—following the European writers—the *nervellus*. This is broken in most genera, but in *Ophiopterus* it is straight. In *Thyreodon* and *Athyreodon* it is broken well above its middle, and in *Ophion* it is usually broken below the middle, but in a few species at or above this point.

The frenal hooks are borne on the anterior margin in two places, along the base of the radial cell and frequently near the base of the median cell. The number varies considerably in a species and often on the two sides of an individual.

Tegulæ.—The tegula is a small chitinous plate lying over the base of and separating the anterior wing from the side of the mesonotum and propleura in front and the mesonotum above. Its surface is smooth or sparsely pubescent. In *Ophiomorpha* the tegulæ are rudimentary or wanting.

Legs.—The legs are long and rather slender, the anterior being shortest and the posterior longest. The coxæ and trochanters are unarmed, but are with the rest of the legs more or less sericeous or pubescent. The coxæ are large and closely articulated with the body, the posterior being usually larger. The shape is conical or subconical, with the insertion of the trochanter dorso-apical. The unarmed femora vary from each other only in size. The anterior tibia is the only one which is shorter than its femur, and bears at its apex, below, an articulated tibial comb. This, in connection with a similar comb on the base of the first tarsal segment, forms a cleaning apparatus often seen in Hymenoptera. Each of the median and posterior tibiæ have two apical spurs, of which the inner is noticeably longer.

The five tarsal joints vary only in length, the first being nearly as long as the other four, the others, except possibly the last, gradually decreasing in length beyond the first. At the apex of the last tarsal segment is a pair of well developed curved claws between which is a large pulvillus. On the inner side of the claw between its base and apex are, except in *Retanisia*, several teeth (pectinate). In *Ophion* these are rather fine, while in *Thyreodon* and *Athyreodon* they are coarse. Aside from size, and the presence of two tibial spurs instead of a cleaning apparatus, the posterior legs differ but little from the others.

Abdomen (Pl. I, figs. 2, 5).—The first true abdominal segment is the median segment, propodeum or, as I have called it following other writers, the metathorax; this has already been described under the thorax. Aside from this the abdomen consists of seven visible segments, with a possibility that in the male the seventh is really the seventh and eighth fused. It is long, falcate and usually strongly compressed laterally except in *Ophion bifoveolatus* and the Genus *Retanisia*. The first two segments are usually somewhat cylindrical, and slightly enlarged at the distal ends; beyond this the abdomen is enlarged more or less acutely, depending on the genus and species. In *Ophiopterus* it is narrow throughout while in most of the other genera it is enlarged beyond the second segment. At the apex are the two short, clavate cerci often seen in other Hymenoptera. In the female the apex of the abdomen is abruptly truncate and from its lower edge projects the ovipositor, with its base hidden in a groove and its apex protected by a short sheath. In most of the genera it is short and stout, but in *Ophiopterus* it is longer and more slender.

In the male the apex of the abdomen is more gradually narrowed and with two subtriangular clasps below. Difference in the shape of these has been given specific value by some, but this seems questionable. Between these and sometimes projecting below them is the short, stout penis.

Sexual distinctions.—Aside from the presence of an ovi-

positor in the female and distinct claspers—copulatory organs —in the males, there is little difference between the two sexes.

Variation.

Variation in color, venation and structure is noticeable in some members of this tribe, and especially in the genera *Ophion*, *Enicospilus* and *Eremotylus*. Here the color of the body varies in some species from luteous to ferruginous, or fuscous, and normally hyaline wings become tinged with fulvous or fuscous, while—in *Thyreodon*—the amount of black in the wings varies widely. The amount and strength of areolation of the metathorax, the character of the radial vein in *Eremotylus*, and that of the discocubital vein in *Ophion* vary considerably; the latter being in some species angularly broken and appendiculate to arcuate. The size of the ocelli has hitherto been considered constant and has been used as a specific character, but some specimens of *Athyreodon* and *Thyreodon* indicate that this is not entirely fixed. The number of frenal hooks has been used as a general specific character but varies considerably in a species, and often even on the two wings of a specimen.

So far as known there are no cases of mimicry in this tribe, but Dr. Ashmead thought that "*T. flammipennis* mimics some of the spider-killing wasps—Ceropalidæ—so common in its habitat."

Abnormalities.

No records of abnormalities in this tribe have come to my attention, but while studying the group I have found several more or less abnormal specimens. One specimen of *Eremotylus macrurus* in the Massachusetts Agricultural College collection has an extra anterior wing on the left side, articulated just in front of the normal anterior wing.* This extra wing has the venation characteristic of the species and ap-

* The specimen was so dried that in spreading the wings to bring out the abnormality for exhibition the extra wing was broken off, but Prof. C. H. and Dr. H. T. Fernald testify to the validity of this abnormality.

parently, though both are of normal size or slightly larger, caused no trouble, for the specimen is otherwise normally developed and in good condition. Abnormal veins or stubs of veins (appendices) are not uncommon in either the anterior or posterior wing. The type of *Ophion abnormis* has an abnormal appendix in both anterior wings, extending from the lower part of the discocubital vein—below the angular fraxure—into the third discoidal cell. Another specimen of this species in the American Entomological Society collection has a similar abnormal appendix, but in the right wing only and nearer the angular fraxure. A specimen of *Eremotylus macrurus* from the same collection has in the right posterior wing an abnormal vein parallel to the upper part of the nervellus—above the fraxure—and connecting the discoidal and cubital veins, thereby forming an abnormal cell. In the left posterior wing this vein is present as two short appendices which do not quite connect in the middle. A specimen of *Ophiopterus ferrugineus* in the United States National Museum, and one of the cotypes of *Nototrachys annulicornis* has an abnormal appendix in both anterior wings extending from near the outer end of the radial vein into the second cubital cell.

Geological History.

Comparatively little is known of the geological history of the tribe, but specimens have been taken in the Tertiary and Quarternary. Serres records *Ophion* " from the lower Oligocene of the Tertiary at Aix in the Provence, Frankreich," and Sordelli records " *Ophion* or *Campolex* from the Quarternary at Pianico, Italy. Scudder states that the family Ichneumonidæ is well represented in Tertiary deposits, though no great number has yet been described. Most of these have been published under the generic names *Pimpla* and *Ichneumon*, the former being represented by seven species from Aix, Radoboj, amber, and British Columbia, and the latter by four, from Aix, Oeningen, Radoboj and Utah, besides which there are references to others in amber and at Aix."

References.

Serres, Geognosie des terrains tertiaires, p. 299.....1829.
Sordelli, Bull. Soc. Ent. Ital., XIV, p. 228, fig.....1882.
Scudder, Bull. U. S. Geol. Surv., No. 31 (Fossil Insects), p. 98...1886.
Morley, British Ichneumons, I, p. 39.....1903.
Handlirsch, Die Fossilen Insekten, pp. 849, 1129.....1906–1908.

Life History and Habits.

Most of the different members of this tribe are often seen flying slowly about shrubbery or in the tall grass during the day from April or early May till late October, but in the tropics and occasionally even in parts of the United States they are taken at various times during the rest of the year. In cloudy or wet weather they seek some sheltered place—at least the diurnal species do—and very little is known of the nocturnal forms, *O. bifoveolatus*, etc. The "longtailed" and "purged" Ophions—*Eremotylus macrurus* and *Enicospilus purgatus*—*Ophion bilineatus* and *Thyreodon morio* are most commonly taken and are most abundant in most collections. The females are more common in museum material owing to their activity in searching for suitable hosts for their eggs, a fact well brought out by the Cornell trap-lantern records which show that only 87 males were taken to 485 females.

The method of oviposition is probably the same for all the members of this tribe, but the shape of the egg and the larval habits, though not well known, appear to vary somewhat, at least the records do not agree. Trouvelot describes the oviposition of *Eremotylus macrurus* as follows: "When an Ichneumon detects the presence of a worm she flies around it for a few seconds, and then rests upon the leaf near her victim; moving her antennæ very rapidly above the body of the worm, but not touching it, and bending her abdomen under the breast, she seizes her ovipositor with her front legs and waits for a favorable moment, when she quickly deposits a small, oval, white egg upon the skin of the larva. She remains quiet for some time and then deposits another egg upon the larva, which only helplessly jerks its body every time

an egg is laid." Dr. Felt adds that "eight to ten eggs are deposited in this manner on the skin, adhering by means of a cement or glue exuded at the moment of oviposition. A few days later they hatch and the larvæ eat their way under the skin of their victim, feeding on the fatty portions of the host at first, but later most of the tissues are devoured. The miserable victim of these parasites drags out a weary existence and usually perishes in the pupal state, rarely before. As a single victim will provide food for the development of but one or two parasites, the weaker ones perish."

Duncan's account does not quite agree with this, for he writes: "The Ophionidæ have a small ovipositor and deposit their eggs *either within* caterpillars that feed on leaves in broad daylight, and are unsheltered, or *upon their skins*. The eggs are somewhat remarkable and have been carefully examined. They are oblong, and have a long twisted peduncle, which is fixed in the skin of the victim. The young larva on hatching breaks its eggshell on the side remote from the peduncle, allows its body still to remain within the pedunculated shell and thus attacks the caterpillar in safety, not entirely leaving the eggshell till it has eaten a hole in the side of its victim." Dr. Packard's observations corroborate this statement for *Paniscus geminatus*, but Dr. Weed states that "the *Ophion* larva is known to feed externally as the nigger wasps, *Bembecidæ*, etc., the egg being strongly fastened to the skin of the victim." The views of Duncan and Weed may apply to some members of the subfamily Ophioninæ, but do not apparently to all members of the tribe Ophionini. The larva, a footless grub, feeds internally or semi-internally, first on the fat bodies, later upon other tissues, and as there is only enough food for one or two parasites the remainder die in the struggle. The host usually lives long enough to spin its cocoon and pupate, in which case the parasite does not need further protection, and often does not spin a cocoon. This habit is common with *E. macrurus* and others which prey upon hosts, spinning stout cocoons, such as the saturnians, etc. The parasite always causes the death of the host, and sometimes the host dies before it can spin up, in which case

the parasite usually crawls to some protected place and spins a cocoon of its own. Thus the cocoons of *E. purgatus* are often found in the soil or under some shelter where its host has transformed, and it is probable that such is the case with all species infesting larvæ that do not spin stout cocoons before pupating. The cocoon when spun is compressed oval, made of fine silk threads tightly glued together with a fluid which sometimes gives it a dark-brown color. The color varies somewhat, but is usually dirty brown or some shade of brown, often with a median transverse, or rarely with a lateral longitudinal band. The interior is often of a lighter color. The mature larvæ of *E. macrurus*, at least, pass the winter within the cocoon, pupating in early spring. Nothing is known of the food, mating habits, etc., of the adults, but it is possible that they feed on decaying animal and vegetable matter, since Dr. Ashmead states that they are attracted to such substances. Morley states that "many kinds of Ophioninæ, including the big red *Ophion luteus*, are freely attracted by sugar. No insect is more fond of sweets, and none more indifferent to bright colored flavorless objects than the Ichneumons. Ophions and Ichneumons will not return to flowers if frightened away." The common Ophions may often be taken around evergreens where they seem to be attracted by the resinous juices.

The literature relating to their biology is as follows:

Trouvelot, Am. Nat., I, pp. 89–91, f. 1.....1867.
Riley, Fourth Ann. Rept. Ins. Missouri, p. 107, ff. 37, 38.....1872.
Vollenhoven, Pinacographia, p. 44, Pl. XXVIII, ff. 1–6.....1880.
Bridgman and Hitch, The Entomologist, XIII, pp. 28–32, Pl. I....1880.
" " Idem, XVIII, pp. 122–128, No. 5, Pl. II.....1884.
Duncan, Transformations of Insects, pp. 2–3.....1882.
Lintner, Ins. N. Y., First Rept., pp. 103–110 (parasitic on *Nephelodes violans* Gn.).....1882.
Packard, Third Rept. U. S. Ent. Comm., p. 128, Pl. II, f. 5. (Larva of *O. purgatus* from cutworms).....1883.
Jack, Can. Ent., XVII, p. 21.....1885.
Webster, F. M., Rept. U. S. Dept. Agr., 1884, p. 289 (parasitic on *Nematus*).....1889.
Cresson, Syn. Hym. N. A., pp. 40–43, 200.....1887.
Riley, Ins. Life, III, pp. 55–276 (feeding habits of larvæ, external).....1891.

Fyles, Twenty-fifth Rept. Ent. Soc. Ont., p. 55, fig. 38.....1894.
Packard, Textbook of Ent., p. 517, figs. 488, 498.....1898.
Morley, British Ichneumons, I, pp. 21–50.....1903.
Felt, N. Y. State Mus., Bull. 76 (nineteenth Rept. State Ent.), pp. 97–125.....1904.
Hitchings, Third Ann. Rept. State Ent. Maine for 1907, p. 12.....1908.
Fiske and Thompson, Journ. Econ. Ent., II, pp. 450–460.....1909.

Economic Importance.

The members of this tribe so far as known are beneficial parasites. Among them are some of our larger and more common parasites, to which much credit is due for controlling a number of insect pests. Most of the species attack lepidopterous larvæ, including the army worm, cotton worm, zebra caterpillar, the large cecropia larvæ, etc. *Ophion bifoveolatus*, however, apparently confines itself to white grubs, the larvæ of Lachnosterna.* The host list of this tribe is very incomplete, especially for the tropical species, but the abundance of many of these indicates that they are important for they cause the death of the host always. *Ophion luteus*, a European form, has a host list of over thirty species, and some of the American members of the tribe may prove to have as many. Experiments at Cornell University show that several species, at least, are attracted to lights in large numbers, a fact which must greatly diminish the value of the trap lantern as a means for destroying insect pests, unless, as in the case with some moths, the female ophionines deposit most of their eggs before they will come to light.

Disease.

Mr. Bitterman, of Nuecestown, Texas, states that he "was stung on the neck by a specimen of *Paniscus geminatus* which had been attracted to a lamp. Serious inflammation soon resulted, which in a few days developed into a swelling. The swelling increased in size until it became a bag six or eight inches long, and the difficulty did not disappear for over six months, at one time seeming to threaten fatal results." In discussing this Dr. Ashmead states the he "has been stung by species of Ophioninæ several times, and be-

* *Ophion* sp. is mentioned by Webster as a possible parasite of a sawfly (*Nematus* sp.).

lieves that ichneumon flies of the subfamily Ophioninæ may produce infection since the insects are attracted to decaying animal and vegetable matter, and might carry bacteria which cause blood poisoning." Walsh states that he "has repeatedly had his fingers pierced by the ovipositor of *Thyreodon morio* and always the puncture gave no more pain and produced no more inflammation than the puncture of a common pin." The members of this tribe will undoubtedly try to use the ovipositor if caught in the hand, and though the smaller species may not perhaps pierce the skin a painful wound could be made by one of the large forms. No poison is, however, injected into the wound, so that the sole danger is from bacterial infection, but in the tropics or under certain conditions elsewhere this deserves consideration. The literature relating to this subject is as follows:

Ophion morio, Walsh, Amer. Ent., I, p. 7 .....1868.
Ophioninæ Ashmead, Idem, p. 47.....1896.
Paniscus Bitterman, Proc. Ent. Soc. Wash., IV, pp. 45–46.....1898.
Ophionidæ Nuttall, Johns Hopkins Reports, VIII, Ins. and Diseases, Nos. 1–2, p. 41 .....1897.
Ophion Morley, British Ichneumons, I, p. 29 .....1903.

Natural Enemies.

At present only two members of this tribe are known to have effective enemies. Over 170 adults of a small chalcidid, *Encyrtus thyreodontis* Ashm., were reared by Mrs. A. K. Dimmock* from a cocoon of *Thyreodon morio*. Fiske and Thompson† report, from investigations at the Gypsy Moth Laboratory, that *E. macrurus* is frequently the victim of secondary parasitism, for the host furnishes food enough for only one parasite, and other parasites, threatened by starvation, attack the larvæ of *E. macrurus* if present. As instances of this they have reared *Theronia fulvescens* Cress.; *Spilocryptus extrematis*‡ Cress.; *Hemiteles periliti* Ashm.; a species of Pimpla

* Dimmock, Proc. Ent. Soc. Wash., IV, pp. 149, 153, 1898.

† Fiske and Thompson, Journ. Econ. Ent., II, p. 4601, 909.

‡ In the paper it is written *Spilocryptus extremis*, but there is no such species. Mr. Fiske states—in litt.—that "it is a lapsus for *P. extrematis* Cress. The specimens show the species to be apparently the form described by Cresson and usually placed as a synonym of *nuncius* Say."

and a tachinid from *E. macrurus* within cocoons of *Samia cecropia* and *Callosamia promethea*. One larva of *Thyreodon morio* was apparently killed by a fungus which attacked its host, *Paonias* (*Smerinthus*) *excæcatus*. Other members of the tribe may be attacked by these or other enemies, but no cases are recorded. Birds, reptiles and amphibia are probably of little importance as enemies. *Eremotylus macrurus* frequently fails to make a proper pupa and Dr. J. B. Smith* records a case where "out of 76 cocoons of this insect only 19 adults were obtained, due not to hyperparasitism, but a simple failure of the larvæ to make a proper pupa." This experience, however, is not a new one, for in years past he "has cut *Ophion* cocoons in large numbers, finding sound larvæ and pupæ as exceptions only, and a putrid, brown, semi-fluid mass as a rule." Mr. Grossbeck states that he has never found anything but the same pasty mass, and therefore it seems that this parasite is kept in check by some disease that reaches it within the body of its host. There is room here, however, for considerable investigation.

Genus **AGATHOPHIONA** Westw.

Agathis, nom. propr. Hym.; *Ophion*, nom. propr. Hym.
Agathophiona Westwood, Tijdschr. v. Ent., Vol. XXV, p. 29.....1882.
" Cameron, Biol. Centr. Amer., Hym., I, p. 298, No. 1, pl. 12, fig. 11.....1886.
" Ashmead, Proc. U. S. Nat. Mus., No. 1206, pp. 89, 162 (Vol. XXXIII, 1901).....1900.
" Dalla Torre, Cat. Hym., III, p. 179.....1901.
" Szepligeti, Gen. Ins.; Hym., 34me Fasc., p. 29.....1905.

Body elongate; abdomen long and compressed, but stouter and thicker than in *Ophion;* head buccate; labium greatly lengthened, bipartite, lobes filiform; neuration of wings similar to *Ophion;* claws pectinate.

Generic type.—♂. *A. fulvicornis* Westw. (monotypical). Location unknown.†

* Smith, Journ. Econ. Ent., I, No. 5, pp. 293–297, 1908.

† It is not in the British Museum and is perhaps destroyed, but may possibly be at Oxford.

Westwood gives the following generic description:

"Body (male) elongate, abdomen long, compressed, slightly clavate at the apex, petiole and second segment following as long as thorax, the two apical lobes horny, compressed, longer than the preceding segment. Head transverse; narrow in front, the sides, behind the eyes, rounded. Antennæ as long as the body; labium short, transverse; mandibles curved, apices deeply bifid; maxillæ elongate' slender, ciliate; maxillary palpi long, slender, five-jointed, the joints of nearly equal length; last segment slender (a very minute segment not seen by me ?); mentum of maxillary long, labrum very long, bipartite, lobes filiform, rostrum slender, curved, more than four times as long as the mentum; labial palpi slender, with four joints of equal length, the apical segment most slender. Thorax obovate, head as wide as the thorax. Wings colored; the anterior with the small second marginal cell (areolet) wanting, the first submarginal area (cubital) confluent with the discoidal."

This genus was erected by Westwood for a single species which is still almost unknown, and has been taken but once since the original description.

Agathophiona fulvicornis Westw.

Agathophiona fulvicornis Westwoood, Tijdschr. v. Ent., Vol. 25, p. 19.....1881.
" " Cameron, Biol. Centr. Amer., Hym., I, p. 1, ♂, Pl. XII, f. 11.....1886.
" " Dalla Torre, Cat. Hym., III, p. 179.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 29, n. 1.....1905.

"*Male, black, shining, antennæ fulvous, except the two basal segments which are black; legs black, tarsi fuscoluteous, the two posterior tibiæ fuscous; wings blackish fuscous, veins black.*"

Length, 18.5 mm.; wings spread 26 mm.

I have not seen a specimen of this species, and can only give a translation of the original description.

Type.—♂. Location unknown.*

According to Cameron's plate the discocubital vein is arcuate as in *Thyreodon*, the nervulus slightly postfurcal, nervellus broken above the middle and the wings fuliginous.

Distribution.—Mexico (San Angel, Chapultepec).

This species is apparently tropical, but its range is not as yet known.

* It is not in the British Museum but may be at Oxford.

Location of specimens.—I do not know what became of Cameron's specimens of this species, but they are not in the British Museum, and no others are recorded.

Genus **OPHION** Fabr.

Ophion Fabricius, Suppl. Ent. Syst., pp. 210, 235.....1798.
" " Syst. Piez., p. 113, n. 18.....1804.
" Olivier, Encycl., Meth., VIII, p. 506.....1811.
" Gravenhorst, Ichn. Europ., III, pp. 686–706.....1829.
" Brullé, Hist. Nat. Ins., Hym., IV, pp. 75, 76, 137.....1846.
" Holmgren, Öfvers. K. Vet. Akad. Förhandl., I, 15, pp. 321–330.....1858.
" Norton, Proc. Ent. Soc. Phila., I, p. 558.....1863.
" Gerstaecker, Handbuch der Zoologie, p. 210.....1863.
" Kirchner, Cat. Hym. Europ., p. 86, App., p. 11.....1867.
" Cresson, Proc. Acad. Nat. Sci. Phila., 1873, p. 374.....1874.
" Taschenberg, Zeitschr. f. d. Ges. Natur., 46, pp. 421–438....1875.
" Vollenhoven, Pinacographia, pp. 44, 61; pl. 28, figs. 1–6; pl. 39, figs. 1–8.....1880.
" Provancher, Faun. Ent. Can., Hym., IV, pp. 348–350.....1883.
" Packard, Proc. Bost. Soc. Nat. Hist., 21, p. 18.....1883.
" Bridgman and Fitch, The Entomologist, 17, pp. 26, 178 ..1884.
" Cameron, Biol. Centr. Amer., Hym., I, pp. 290, 293.....1886.
" Cresson, Syn. Hym. N. A., pp. 43, 149, 200.....1887.
" Riley, Ius. Life, I, p. 98.....1888.
" Thomson, Opusc., Ent., 12, p. 1187.....1888.
" Brauns, Arch. Ver. d. Nat. Mecklenb., pp. 75, 86.....1889.
" Webster, Ins. Life, IV, p. 179.....1891.
" Ashmead, Smith's Ins. N. J., p. 580 (second edition)..... 1899.
" " Proc. U. S. Nat. Mus., No. 1206, pp. 87, 180 (Vol. XXIII, 1901).....1900.
" Dickinson, Moths and Butterflies, p. 177, fig. 160.....1901.
" Dalla Torre, Cat. Hym., III, p. 187.....1902.
" Eliot and Soule, Caterpillars and Their Moths, p. 257.....1902.
" Felt, N. Y. State Mus., Bull. 76, pp. 101, 113 (nineteenth State Ent. Rep.),.....1903.
" Szepligeti, Gen. Ins., Hym., 34me Fasc., pp. 22, 29.....1905.
" Schmiedeknecht, Hym. Mitteleurop., p. 593, 110.....1907.
" " Opusc. Ichneum., XVIII, p. 1438.....1908.
" Morley, The Entomologist, XLII, p. 136, June.....1909.
" Viereck, Smith's Ins. N. J., p. 621 (third edition).....1910.

Anterior wing with distinct stigma, discocubital vein usually angularly broken and appendiculate, base of radius straight, not thickened, radial and cubital veins usually

strongly converging, nervellus usually broken below the middle ; antennæ long, filiform ; wings without areola or macula, discocubital cell receiving both recurrent veins ; intermediate tibiæ with two apical spurs, claws pectinate ; abdomen usually strongly compressed.

Generic type.—*O. luteus* L.*

The American members of this genus are medium sized insects compared with others of the tribe, smaller than the Thyreodons or Athyreodons. They are usually flavo-fulvous, sometimes marked with fuscous or black, and closely resemble members of the Genus *Paniscus*, but may be readily separated by the presence of an areolet in the latter. In most Ophions the discocubital vein is angularly broken and appendiculate, but in *bifoveolatus*, *chilensis* and a few others this vein is frequently only angularly bent or almost arcuate aud the appendix rudimentary or wanting. In these species the ocelli are nearly as small as in *Thyreodon*, and the nervellus, is often broken above the middle, but the presence of a distinct stigma places them at once in the Genus *Ophion*, for in *Thyreodon* the stigma is lacking. Members of the Genus *Eremotylus* may be readilv separated by characters of venation ; the basal half of the radius being thickened and the third discoidal cell long and narrow, while it is short and broad in *Ophion*. This, the oldest genus of the tribe, was proposed by Fabricius in 1798 and characterized as follows :

"Mouth with clypeus short, rounded, entire ; four unequally elongated, filiform palpi, the anterior longer, with six cylindrical segments ; the maxillæ attached behind to the posterior which are four-jointed and attached to the top of the labium above. Mandibles horny, curved, bidentate. Maxillæ short, membranaceous, entire. Labium short, ovate, membranaceous, entire, attached to the palpiger. Antennæ setaceous."

Twenty-one species were designated and given the usual short descriptions of the day. Many of these, *luteus*, etc., are well known and still retained in the Genus *Ophion*, but quite a number—among which are the American species described, *flavus*, *morio* and *relictus*—have been removed to

* Designated by Curtis, Brit. Ent., 13, p. 600, 1836; Westwood' Generic Synopsis, p. 60, 1839.

other later genera. Other genera were eventually proposed and the genus gradually narrowed down to its present limits. From this it will be seen that the Genus *Ophion* originally covered, intentionally or otherwise, a field nearly as wide as that now covered by the subfamily Ophioninæ. In 1829 Gravenhorst revised the Superfamily Ichneumonoidea, and Brauns accepted many of his views, giving in 1889 the following characters for this genus :

"Head short, transverse, clypeus hardly discernible, foveola distinct on both sides, apex truncate. Mandibles equally bidentate, antennæ rufous, metathorax rarely distinctly areolated, generally with two transverse basal carinæ, sometimes abbreviated or not interrupted behind ; front wings with basal and cubital veins strongly converging ; broken in the middle, very often giving off a branch. Mesosternum with median half emarginate, the two basal segments with deep foveæ. Claws pectinate."

On another page he adds :

"Wings without areola, discocubital cell receiving both recurrent nervures, generally angularly broken, with an appendix ; cubital and basal veins strongly converging."

Schmiedeknecht summarizes this in his recent work on Hymenoptera of Middle Europe, but credits the genus to Gravenhorst, evidently basing this view on Gravenhorst's revision and considering the *Ophion* of Fabricius as a subfamily. This view can not, however, be accepted ; the Genus *Ophion* was in all of its revision credited to Fabricius and the International Code of Nomenclature offers no excuse for change.

Distribution.

The members of this the largest genus in the tribe are found all over the world. The American species are widely distributed from southern Alaska to Patagonia, Argentina, including the West Indies. *O. bilineatus* has the widest range, apparently occurring over all the above named American territory, but the other species are more restricted.

Life History and Habits.

Comparatively little is known of the life history or habits of members of this genus in spite of the fact that they are

common and widely distributed. This is probably due to the crepuscular or nocturnal habits of the majority. *O. bifoveolatus* is an exception, but the others, so far as known, fly at night or in the evening and are often attracted to light. The adults appear in early spring, and have been taken in Massachusetts from early April till late October, but are most abundant in June, July and August. The date of emergence will probably be earlier for tropical countries, but so far as known the winter is passed in the larval or pupal state. The cocoons are about half an inch long by a quarter of an inch thick in the middle, slightly flattened, oval in shape, composed of brownish silk, sometimes darker towards the ends. The habits probably differ little from those of other members of the tribe which are treated on page 14.

Economic Importance.

The economic importance of this genus can not be estimated, for our knowledge of their hosts is too limited, but so far as known they are, with one exception, restricted to Lepidoptera. *O. luteus*—a European form—has a host list of twenty-nine or more insects, and there is no reason why the American species, especially such a widely distributed form as *O. bilineatus*, should be more restricted. *O. bifoveolatus* forms a noteworthy departure from the other members of the tribe, and apparently preys entirely upon white grubs—the larvæ of *Lachnosterna fusca* and perhaps other species of this genus. Prof. F. M. Webster records having observed an insect resembling an Ophion ovipositing in the larva of a sawfly—*Nematus* sp.—but there is doubt as to the identity of the parasite, and this would be the only known case of an Ophionine parasitizing a hymenopteron.

Variation.

The members of this genus show no striking variation in structure or color, and several of the species are so closely related that it is only after careful study that they can be separated. The shape of the discocubital cell and character of the surface of the metathorax show in some species considerable variation. The discocubital vein is normally angu-

larly broken and appendiculate, but a good series of *O. bifoveolatus, chilensis* and a few others shows at once that in these species it is sometimes only angularly bent or almost arcuate and the appendix rudimentary or entirely wanting. The character of the surface of the metathorax also varies markedly, as in *bilineatus*, where it varies from smooth or slightly reticulate to distinctly reticulate. The ocelli are normally medium sized, but in *O. costale* they are as small as in *Thyreodon*.

Table of Species.

1. Wings subfuliginous or fuliginous ..... 2.
   Wings hyaline, only slightly fuscous or fulvous ..... 6.
2. Discocubital vein arcuate, nervellus broken at or above the middle .. 3.
   Discocubital vein angularly broken or appendiculate, nervellus broken at or below the middle ..... 5.
3. Posterior ocelli connected with the tops of the eyes by a deep black furrow ..... **costale** Cress.
   Posterior ocelli not connected with the tops of the eyes by a deep black furrow ..... 4.
4. Eyes small, thoracic sutures, pleuræ, pectus and mesothorax partly black ..... **bifoveolatus nigrovarius** Prov.
   Eyes not small, thoracic sutures not marked with black.
5. Abdomen long and slender, antennæ shorter than the body. **bilineatus elongatus** n. subsp.
   Abdomen not long and slender, antennæ longer than the body. **slossonæ** Davis.
6. Abdomen stout, not strongly compressed; eyes small, distant from the base of the mandibles ..... **bifoveolatus** Br.
   Abdomen usually strongly compressed ..... 7.
7. Eyes small, distant from base of mandibles ..... 8.
   Eyes not small, not distant from base of mandibles ..... 12.
8. Base of discocubital vein twice angularly broken, appendix directed downward ..... **abnormis maginiceps** n. subsp.
   Base of discocubital vein not twice angularly broken, appendix not directed downward ..... 9.
9. Antennæ black ..... **melanostigma** Cam.
   Antennæ not black ..... 10.
10. Ocelli small, the posterior connected with the tops of the eyes by a deep black furrow ..... **bilineatus nigrovarius** Br.
    Ocelli not small, not connected with tops of eyes by a deep black furrow ..... 11.
11. Wings hyaline (or slightly fuscous) ..... 16.
    Wings with distinct fulvous tinge ..... **coloradensis** Felt.

12. Glaucous, to flavous with distinct ferruginous markings. **chilensis** Spin.
    Not glaucous, fulvous to ferruginous or luteous....13.
13. Flavous to light or dark fulvous, eyes black....14.
    Luteous (eyes flavous) or testaceous....15.
14. Face broadly projecting, with distinct longish tubercle below antennæ....**ancyloneura** Cam.
    Face not broadly projecting, with distinct longish tubercle below antennæ....**bilineatus** Say.
15. Discocubital vein twice angularly broken, stigma fuscous. **biangularis** Tasch.
    Discocubital vein once angularly broken, stigma luteous....17.
16. Eyes small, distant from base of mandibles....**abnormis** Felt.
    Eyes medium, body glaucous to bright straw-yellow, marked with ferruginous....**chilensis** Spin.
17. Face broadly projecting....**flavo-orbitalis** Cam.
    Face not broadly projecting....**chiriquensis** Cam.

Ophion costale Cress.

Ophion costale Cresson, Proc. Acad. Sci. Phila., p. 366, ♀, Cal....1878.
" " Syn. Hym. N. A., p. 200....1887.
" *costalis* Dalla Torre, Cat. Hym., III, p. 189....1901.
" *costale* Felt, N. Y. State Mus., Bull. 76, p. 123 (Nineteenth State Ent. Rept.)....1903.
" *gilletti* Felt, Idem, p. 123, Col....1903.
" *costalis* Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 116....1905.

Fulvo-ferruginous, wings subhyaline, thoracic sutures black, eyes small, distant from base of mandibles, posterior ocelli connected with the tops of the eyes by a deep black furrow, nervellus broken well above the middle.

Length, 9–14 mm.; wing, 8–9 mm.; spread, 18–19 mm.; antennæ, 10 mm.

Fulvo-ferruginous, varied with black; head large; eyes small, only slightly emarginate, distant from the base of the mandibles; ocelli small, the posterior twice their width from the tops of the eyes, but connected with them by two deep black furrows; antennæ dark ferruginous, shorter and thicker than usual; antennal fossa ringed with dark brown or black and with a distinct black hollowed area just above; clypeal foveæ and base and tips of mandibles black; a weak median keel extends from between the eyes to the base of the clypeus; face slightly swollen, clothed with fine short pubescence; shining behind the eyes, in front closely punctured, as in the clypeus; labrum large and evenly rounded.

Thorax polished, sericeous, with deeply impressed, black sutures; the posterior suture of the metapleuræ finely beaded; scutellum rounded; metathorax smoothly rounded behind, without distinct carinæ; *wings* subhyaline, fulvoferruginous, stained with yellowish at the base and with fuscous along the costal and apical margins, deepest in the radial and marginal cells stigma well developed, flavous; discocubital vein evenly bent, not appendiculate, nervulus slightly postfurcal, nervellus broken well above the middle; first recurrent vein not over half the length of the second, basal vein slightly bent at its lower end, towards the base of the wing; legs ferruginous, except the anterior and median trochanters and the articulation of the trochanters and coxæ, which are black; claws pectinate.

Abdomen strongly compressed, slightly darker colored and varied with black.

Redescribed from the type and one additional female specimen.

Type.—♀. No. 63, American Entomological Society of Philadelphia.

This species is closely related to *O. bifoveolatus*, and may prove to be only a subspecies. Mr. E. T. Cresson described this species from a single female, which has long stood as unique, and consquently has been regarded as possibly a sport. On examining the ♀ type of *Genophion gilletti* Felt, however, I found that it was synonymous, and the existence of this second specimen shows that the characters are fairly well fixed. Dr. Felt erected for this and another species a new genus—*Genophion*—based on "the very elongated face," but this occurs in other species and genera to an equal degree, and can not, I believe, be given generic value. The apparent length of face is largely due to the decrease in the size of the eyes and is frequently seen in the specimens of *O. bifoveolatus*.

Distribution.—This rare species is recorded as having been taken in Klamath County, Cal.,* and Colorado, but as it is represented by only two specimens its range is not known.

Nothing is known of the life history, habits or hosts.

* There is no Klamath County, Cal., so this must refer to the town of Klamath in the northwestern corner of California County, Oregon, which lies on California's northern border.

Location of specimens.—American Entomological Society (Philadelphia Academy of Natural Sciences), ♀. Type No. 63, Klamath County, Cal. N. Y. State Museum (Albany), ♀, Colorado.

Ophion bifoveolatus nigrovarius.

Ophion nigrovarius Provancher, Nat. Can., VI, p. 704, ♀ ♂, Can..1874.
" " " " " XI, p. 118, b, n. 5, ♀ ♂ .....1879.
" " " Faun. Ent. Can., Hym., II, p. 351, n. 5, ♀ ♂ .....1883.
" " Dalla Torre, Cat. Hym., III, p. 196.....1901.
" *nigrovarium* Felt, N. Y. State Mus., Bull. 76, p. 121, Col., Can .....1903.
" *nigrovarius* Szepligeti, Gen. Ins, Hym., 34me Fasc., p. 32, n. 17.....1905.

Fulvo-ferruginous varied with black; eyes small, distant from base of mandibles; thoracic sutures, pleuræ, pectus and metathorax partly black, wings tinged with fuscous, scutellum flavous.

Length, 14–20 mm.; wing, 11–14 mm.; spread, 24–30 mm.; antennæ, 10–16 mm.

Fulvo-ferruginous varied with black; clothed with fine short pubescence; eyes small, distant from the base of the mandibles, only very slightly emarginate; ocelli prominent, well separated, the posterior not far from the top of the eyes; face broad, more or less flavous, antennæ ferruginous, rather shorter and stouter than usual, their fossæ often black, clypeal foveæ deep black.

Thorax flavofulvous, varied with ferruginous and black; the thoracic sutures, pleuræ, pectus and base of the metathorax more or less black; scutellum usually flavous; metathorax without distinct keels although two to three weak median longitudinal keels are sometimes present; *wings* slightly smoky; stigma fulvous, costal nervure brown, the others dark fuscous; discocubital vein usually not appendiculate though a trace of an appendix is often present and is occasionally distinct; nervulus antefurcal to interstitial, nervellus broken at or slightly above the middle.

Legs of the general color, coxæ more or less fuscous, often almost entirely flavous in the female; feet yellow; claws pectinate

Abdomen of the general color, varied with black.

In describing this species I have compared three ♀ specimens with the various descriptions.

Types.—♀ ♂. Location unknown.

This form is so closely related to *O. bifoveolatus* that it can

be considered only a subspecies ; breeding experiments may show that it is only a melanic form of *bifoveolatus*, for the structure agrees throughout, but until we have such evidence it seems wise to preserve it as a subspecies. Provancher states that the female is of a clearer yellow than the male, but I do not have sufficient material to settle this.

Distribution.—This subspecies has a somewhat limited distribution through the northern United States and southern Canada. Its exact range is not known, but it has been reported, and I have seen specimens, from Colorado and Canada.

Location of specimens.—American Entomological Society (Philadelphia Academy of Natural Sciences), Canada, Colorado. U. S. National Museum, Canada, Colorado.

Ophion subfuliginosus Ashm.

Ophion subfuliginosus Ashmead, Proc. Cal. Acad. Sci., IV, p. 126, n. 11, ♀ ♂, El Taste, El Chinche, Lower California.....1894.
" " Dalla Torre, Cat. Hym., III, p. 199.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 21.....1906.

Brownish ferruginous ; wings subhyaline, stigma fulvous, nervures black, discocubital vein angularly bent, not appendiculate, nervulus antefurcal to interstitial, nervellus broken well below the middle.

Length, 12–16 mm. ; wing, 8–12 mm. ; spread, 17.5–25 mm. ; antennæ, 12–18 mm.

Brownish ferruginous ; head transverse, polished, impunctate, except the face and clypeus which are very finely punctured and clothed with fine white pubescence ; ocelli large, the posterior close to the tops of the eyes ; eyes slightly emarginate ; antennæ as long as the body or a little longer, the first flagellar segment as long as or longer than the scape ; clypeus with a cluster of long hairs, and separated from the face by deep foveæ ; labrum triangular.

Thorax smooth, polished, or at the most with sparse microscopic punctures, scutellum tinged with yellow, bordered by lateral keels connecting it with the mesonotum ; metathorax and lower part of the mesopleuræ closely punctate, the posterior face of the mesothorax with two arcuate transverse carinæ and two median longitudinal carinæ which form a shallow median longitudinal furrow.

Wings tinged with fuscous, especially in the radial cell ; stigma fulvous,

nervures fuscous to black, sometimes varied with flavous; discocubital vein obtuse-angularly bent or broken, but without trace of an appendix; nervulus antefurcal to interstitial, nervellus broken at or below the middle; first recurrent vein not over half the length of the second; legs of general color, claws pectinate.

Abdomen about two and one-half times as long as the thorax, compressed, smooth, and shining, clothed with fine short pubescence, the first segment one-third longer than the second.

In describing this species I have compared the types and three ♀ specimens with the original description.

Types.—♂ ♀. No. 6138, U. S. National Museum.

This is one of the smaller, rarer, species, which is not well known. It may be readily recognized by its small size, wings tinged with fuscous, and the discocubital nervures not appendiculate. A larger series may show that the discocubital vein is, as in *bifoveolatus*, sometimes appendiculate.

Distribution.—Lower California, New Mexico.

This species appears to range through southwestern United States and northern Mexico. The types were taken at El Taste and El Chinche, Lower California, Mexico, and two ♀ specimens in the National Museum come from San Jose del Cabo, Lower California, while a specimen in the American Entomological Society Museum, which seems to belong here, comes from New Mexico. Nothing is known of the life history, habits or hosts.

Location of specimens.—U. S. National Museum, cotypes ♀, No. 6138, El Taste, Lower California, Mexico; ♀, No. 6138, El Chinche, Lower California, Mexico; two ♀'s, San Jose del Cabo, Lower California, Mexico; one, Virginia. American Entomological Society, ♀, New Mexico.

Ophion bilineatus elongatus n. subsp.

Fulvo-ferruginous, abdomen long and slender, antennæ short, wings subfuliginous, discocubital vein angularly broken, appendiculate; nervulus antefurcal to interstitial, nervellus broken at or near the middle.

Length, 24–29 mm.; wing, 14–17 mm.; spread, 30–36 mm.; antennæ, 13–16 mm.

Fulvo-ferruginous, smooth and shining, with scanty, short white pubescence; head of the general color, the eyes frequently surrounded by a narrow band of fulvous; ocelli large, well separated; eyes large, emarginate; antennæ shorter than usual, ferruginous, their tips

slightly darker; clypeal foveæ distinct; mandibles stout, bidentate, tipped with black.

Thorax of the general color, smooth and shining or at the most with microscopic punctation; mesonotum with its parapsidal furrows distinct only at the anterior edge; metathorax with two transverse carinæ, the anterior even, the median angularly arched and behind it several indistinct carinæ radiating from the insertion of the abdomen.

Wings distinctly smoky, stigma flavous, nervures black; discocubital vein appendiculate, nervulus antefurcal to interstitial, nervellus broken at or near the middle.

Legs of the general color or slightly lighter; abdomen often varied with black, long and slender, strongly compressed.

Described from three ♀ cotypes.

Cotypes.—Three ♀'s, American Entomological Society.

This subspecies may be readily recognized by the long slender abdomen, which I have not seen in any other species. This, with the subfuliginous wings and reddish-brown color, makes it conspicuous in a series of Ophions. In structure and color, aside from the long slender abdomen, it agrees with dark specimens of *bilineatus*.

Distribution.—Colorado.

Ophion slossonæ Davis.*

Ophion slossonæ Davis, Ent. Mus., IV, p. 135, ♀, orig. descrip. Conn.; Carbondale, Ill.....1893.
" " Ashmead, Trans. Amer. Ent. Soc., XXIII, p. 193. (apparently a syn. of *T. texanus* Ashm.).....1896.
" " Dalla Torre, Cat. Hym., III, p. 198, listed.....1901.
" *ferrugipennis* Felt, N. Y. Mus., Bull. 76 (nineteenth Rept. State Ent.), p. 122, pl. 2, fig. 1, N. Y .....1903.
" *slossonæ* Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 120, listed.....1905.

Ferruginous to fulvo-ferruginous, wings tinged with fuscous or entirely deep fuliginous, discocubital vein appendiculate, nervures black, stigma fulvous.

Length, 19–25 mm.; wing, 18–22 mm.; spread, 38–46 mm.; antennæ, 22–28 mm.

Fulvo-ferruginous to ferruginous, clothed with fine short pubescence,

* Mr. Davis writes: "I take pleasure in dedicating this new species of *Ophion* to Mrs. Annie T. Slosson who bred the specimen from a dark cocoon of one of the larger species of Acronycta (Apatela) last season (1882). The parasitized cocoon was taken in Connecticut."

face finely punctured; eyes large, slightly emarginate, surrounded by an irregular yellow band; vertex varied to flavous; ocelli large, prominent, well separated, in one case by a distinct furrow, the two posterior close to the tops of the eyes; antennæ as long as body, fulvo-ferruginous, apex sometimes fuscous; clypeal foveæ distinct; mandibles bidentate, tipped with black.

Thorax and abdomen frequently dark ferruginous.

Thorax sericeous, shining; parapsidal furrows well developed anteriorly, extending back one-third the length of the mesonotum; scutellum connected with the mesonotum by more or less prominent lateral keels; metathorax areolate, with two transverse and six or eight longitudinal distinct keels, the latter emanating from the insertion of the abdomen, the latter edge of the third median area frequently separated by an extra keel.

Wings slightly fuscous to deep fuliginous, iridescent, often with dark spots in the radial cell of the hind wing; stigma and base of costa fulvous, nervures otherwise fuscous; discocubital vein angularly broken and appendiculate, the appendix extending one-third to one-half way across the cell; nervulus antefurcal to interstitial; nervellus broken at or below the middle; first recurrent vein not half the length of the second. Legs fulvous to light ferruginous, usually lighter than the rest of the body, posterior tarsi sometimes marked with black, claws pectinate, black.

Abdomen strongly compressed, apex usually darker.

Redescribed from ♂ type, eight ♀ and five ♂ specimens.

Type.—♂, No. 81, and paratype, ♂, No. 81, American Entomological Society, Philadelphia.

This species is related to *Ophion bilineatus*, but may be easily recognized by the more or less fuliginous wings, stronger and differently arranged areolation of the mesothorax and larger size. It has been confused with *Eremotylus texanus* Ashmead, and Dr. Ashmead (Transactions American Entomological Society, 23, 193) thought it "apparently a synonym of that species." They are, however, distinct, and belong to different genera, as the different venation, areolation of metathorax, etc., show. This might have been learned by a careful study of the original descriptions, but comparison of the types and a good series of specimens leaves no room for doubt. Similarity of description indicates that *Ophion ferruginipennis* Felt is a synonym of *O. slossonæ*, and the types which I have examined show that this is the case.

Distribution.—Grand Lake, Newfoundland, to Williamsport, Pa., and Carbondale, Ill.

This species ranges from the lower Boreal at 45° to the lower edge of the Upper Austral at 38°, and possibly into the Lower Austral zones. I have seen specimens taken at Grand Lake, Newfoundland; Amherst and Cohasset, Mass.; Connecticut; Ithaca and New York City, N. Y.; Williamsport, Pa., and Carbondale, Ill.

Life history and habits, etc.—Little is known of the life history and habits of this species. It has been taken from June 2 to September 7, but seems to be most abundant in August and September. Its value as a parasite can not be determined as the list of hosts is very incomplete. The type was "bred from a dark cocoon of one of the larger species of *Apatela* (*Acronycta*); the parasitized cocoon was taken in Connecticut."

Location of specimens.—American Entomological Society (Philadelphia Academy of Natural Sciences), type ♂, No. 81, one, Connecticut; paratype, ♂, No. 81, two, Carbondale, Ill. U. S. National Museum, homotype, ♂; Boston Society Natural History, eight ♂'s, three ♀'s. Leland Stanford University, homotype, ♀, Ithaca, N. Y. Minnesota State College, ♀, Minnesota, wings light. New York State Museum, Albany, ♀, New York City. Massachusetts Agricultural College, homotypes, two ♂'s and two ♀'s, Amherst, Mass.

Ophion bifoveolatus Brullé.

Ophion bifoveolatus Brullé, Hist. Nat. Ins., IV, Hym., p. 138, ♀ ♂.....1846.
" " Cresson, Proc. Ent. Soc. Phila., I, p. 206, Md., Ark., Ill.....1862.
" " Norton, Proc. Ent. Soc. Phila., I., p. 358, N. Y., 5.....1863.
" " Cresson, Proc. Ent. Soc. Phila., IV, p. 284, Colo.1865.
" " " Trans. Ent. Soc. Phila., IV, p. 169, Texas.....1873.
" " Provancher, Nat. Can., VI, p. 103.....1879.
" " " Idem, XI, pp. 117, 118.....1879.
" " " Faun. Ent. Can., II, Hym., p. 351, n. 4, ♀ ♂, Can .....1838.

Ophion bifoveolatus Ashmead, Colo. Biol. Assn., Bull. I, p. 43, Colo.....1890.
" " Ashmead, Smith's Cat. Ins. N. J., p. 25 (also 1900 edition, p. 581).....1890.
" *bifoveolatum* Forbes, Ins. Ill., 18th Rept., p. 125.....1891–2.
" " Osborn, Partial Cat. Animals of Ia., p. 15....1892.
" " Riley, Proc. Ent. Soc. Wash., II, p. 134.....1892.
" " Slosson, Ent. News, V, p. 4, Alpine regions of Mt. Washington.....1894.
" *bifoveolatum* Forbes, Ill. Agr. Exp. Sta., Bull. 44, p. 272.1896.
" *bifoveolatus* Dalla Torre, Cat. Hym., III, p, 188, Am. bor..1901.
" *bifoveolatum* Felt, N. Y. State Mus., Bull. 76, p. 119, pl. II, fig. 2.....1904.
" *bifoveolatus* Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 112, Am. bor.....1905.
" *bifoveolatum*, Forbes, Ill. Agr. Exp. Sta., Bull. 116, p. 473..1907.
" " Felt, N. Y. State Mus., Bull. 124, p. 43.....1908.
" " Forbes, 24th Rept. Ill. State Ent., p. 161, bred from white grubs.....1908.
" " Viereck, Smith's Ins. N. J., p. 621. .....1910.

Fulvo-ferruginous, eyes small, distant from base of the mandibles, abdomen not strongly compressed, discocubital vein rarely appendiculate, costal vein inclined to black.

Length, 12–22 mm.; wing, 9–17 mm.; spread, 20–36 mm.; antennæ, 12–17 mm.

Light fulvous to ferruginous, face broad, frequently fulvous, ocelli prominent, equidistant; eyes small, distant from the base of the mandibles, very slightly emarginate; antennæ dark brown, their apices frequently darker, stout, not as long as the body; clypeal foveæ deep, usually black.

Thorax fulvous to ferruginous, finely punctured, with the sutures sometimes darker; mesonotum convex, usually smooth.

Scutellum and postscutellum prominent, the former sometimes light ferruginous; metathorax with a weak median transverse carina and behind it several weak median longitudinal carinæ, all of which are more or less distinct.

Wings hyaline or tinged with fuscous; stigma well developed, fulvous; nervures black; discocubital vein angularly bent but usually without an appendix, though a trace of one is frequently present, and sometimes a distinct appendix; bulla of the second recurrent vein usually close to the tip of the discocubital vein; nervulus interstitial to antefurcal; nervellus broken above the middle.

Legs uniformly fulvo-ferruginous; claws pectinate.

Abdomen not strongly compresssed, but relatively thicker and shorter then usual; rarely considerably compressed; often darker at the tip; male clasps stout, rather long, obliquely rounded.

In describing this species I have compared numerous specimens with the descriptions.

Type.— ♀ ♂. Location unknown to me.

This species is readily recognized by the small eyes, broad face, abdomen not strongly compressed and discocubital vein generally not appendiculate; there is the usual variation towards the light and dark forms. Brullé's type was evidently one of the lighter forms in which the head, thorax, and sometimes the legs and first abdominal segment are light fulvous, the rest ferruginous; the dark forms are entirely ferruginous, and between these are all sorts of gradations. The thorax is sometimes marked with black, and *O. bifoveolatus nigrovarius* is evidently an extreme case of this.

Distribution.—This species is generally distributed throughout the United States, ranging from southern Canada to northern Mexico.

Specimens have been taken in Ottawa, Canada; Mt. Washington, N. H.; Pennsylvania; California; Illinois; Montana, and many intervening localities.

Life history.—This species is one of the most common of the genus and well represented in collections; this is partly due perhaps to the fact that it seems to be diurnal, and not crepuscular or nocturnal as is the case with some closely related forms; in the Cornell trap-lantern experiments very few specimens, compared with the newly related *O. bilineatus* Say, were taken. The adults usually appear about the middle or last of May and early in June, but specimens have been taken in Massachusetts as early as May 4; at Ottawa, Canada, May 30; at Palo Alto, Cal., March 25; and in Illinois, March 11 and April 27 to September 1. They are probably most abundant in June and July, but Prof. Forbes states that in Illinois they emerge in breeding cages from March 31 to April 27. Little is known of its life history, but it is somewhat peculiar in being parasitic upon white grubs—the larvæ of *Lachnosterna fusca* and probably of other species. In one case the head and skin of a grub were woven into the wall of the cocoon of the parasite. A specimen in the Massa-

chusetts Agricultural College collection—from the Gypsy Moth Laboratory in Malden—emerged, according to the label, from a *promethea* cocoon. This, however, seems doubtful, and can not be accepted without further evidence. It has been frequently reported as parasitic upon *Lachnosterna fusca*, and its activities may account for these insects not becoming more serious pests. The cocoon is about a half inch long by a quarter thick in the middle, made of dull gray silk, frequently darker towards the ends, and thus forming a median band of lighter color.

Hosts.

Lachnosterna fusca Froh.; Riley, Proc. Ent. Soc. Wash., II, p. 134.....1892.

Callosamia promethea Drury, noted above.

Location of specimens.—Colorado State College, Leland Stanford University, Iowa State College, Illinois State College, Massachusetts Agricultural College, Minnesota Agricultural College, Montana Agricultural College, New York State Museum, American Entomological Society, U. S. National Museum. In the U. S. National Museum from Canada; Hartford, Conn. (May 30); New York; Pennsylvania; Virginia; Colorado; Missouri and Texas.

Ophion abnormis magniceps n. subsp.

Flavous to dark fulvous, varied with ferruginous; head large; eyes small, distant from base of mandibles; discocubital vein biangularly broken, and appendiculate, the appendix or its rudiment directed downward; stigma and costa flavous bordered with black below, nervures black; veins enclosing the cell thickened, those at the apex very slender.

Length, 12–16 mm.; wing, 11-13 mm.; spread, 24-28 mm.; antennæ (missing).

Flavous to dark fulvous, varied with ferruginous; smooth and shining, with fine short pubescence; head large, face broad; ocelli medium to small, distant from the tops of the eyes; eyes small, narrow, only slightly emarginate, distant from the base of the mandibles; antennæ fulvous, probably shorter than the body; clypeal foveæ deep; mandibles bidentate, tipped with black.

Thorax smooth and shining; mesonotum with more or less distinct ferruginous stripes, metathorax smooth or very finely punctured, with indistinct carinæ.

Wings hyaline or slightly tinged with fuscous; stigma and costa flavous, bordered with black below; nervures black, those enclosing the cell thickened, those at the apex beyond the closed cells slender and—except from the radial vein—even somewhat indistinct at the outer end; base of radial vein straight and slender; discocubital nervure twice angularly broken and appendiculate, with its appendix directed downward; nervulus well antefurcal to interstitial, nervellus broken below the middle; legs light to dark flavous, claws pectinate; abdomen flavous to dark fulvous, more or less varied with black.

Described from ♀ and ♂ types.

Types.—♀ ♂. American Entomological Society Collection.

This subspecies is closely related to *O. abnormis*, having the large broad head, small eyes, etc., but it may be readily separated from that species by characters of the venation. The basal nervures, as far as the apex of the closed cells, are noticeably thickened throughout, while those beyond are more slender than usual, and in their outer ends may almost disappear (except for the radial). The shape of the third discoidal cell and the discocubital vein, twice angularly broken with the appendix pointed downward, are also quite different. I am not satisfied that these characters are all well fixed, but a series of specimens would settle this point. If the characters are well fixed I believe that they are of specific value, but in the absence of such evidence I can only place this insect as a subspecies.

Distribution.—This subspecies appears to have a similar range to *abnormis*, along the mountain ranges of the western United States; the cotypes come from Montana and southern California. Nothing is known of the life history, habits or hosts.

Location of specimens.—American Entomological Society. Cotypes ♀ and ♂, southern California, Montana.

Ophion melanostigma Cam.

Ophion melanostigma Cameron, Biol. Centr. Amer., Hym., I, p. 293, n. 14, ♂, pl. 12, fig. 18.....1886.
" " Dalla Torre, Cat. Hym., III, p. 195.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 105.....1905.

Luteous, eyes and thorax sulphur-yellow, antennæ black, wings hyaline, stigma and nervures black.

Length, 23 mm.

Head strongly punctured, a longish, clearly defined tubercle below the antennæ; antennal regions projecting, separated from the eyes by an oblique depression which extends near to the inner side of each antenna; tips of the mandibles piceous black; antennæ longer than the body, densely pilose, the third joint longer than the fourth and fifth together, black, with the apical joints brownish; thorax pilose, shining, impunctate; metanotum without keels.

Wings hyaline, stigma and nervures black; discocubital vein arcuate, not appendiculate; bulla received a little beyond the middle; nervulus interstitial, nervellus broken below the middle.

I have not seen the type or a specimen of this species, and can only give the slightly modified original description.

Type.—British Museum.

This species may apparently be readily recognized by the black antennæ and arcuate discocubital vein, though these may vary to some extent.

Distribution. — Panama (Volcan de Chiriqui, 2,000–3,000 feet).

Ophion coloradensis Felt.

Genophion coloradensis Felt, New York State Mus., Bull. 76, p. 124, ♀ (nineteenth Rept. State Ent.).....1904.

Ferruginous, thoracic sutures black, eyes small, wings hyaline tinged with fulvous, discocubital vein angularly broken and appendiculate.

Length, 9–12 mm.; wing, 9–12 mm.; spread, 20–25 mm.; antennæ, 13 mm.

Ferruginous; ocelli small, nearly contiguous, the posterior distant from tops of eyes their own diameter; eyes small, distant from the base of the mandibles, only slightly emarginate; antennæ fulvous, about as long as the body; clypeal foveæ deep, dark brown.

Thorax ferruginous with sutures black, metathorax with three well-developed carinæ, one dorsal, two lateral, radiating from the insertion of the abdomen; wings hyaline, basal half tinged with fulvous; stigma flavous, nervures fulvous, discocubital vein angularly broken and more or less distinctly appendiculate—in one type only a notch, and in the other well marked—nervulus antefurcal to interstitial, nervellus broken below the middle; first recurrent vein about one-half the length of the second; bulla of second recurrent vein near the discocubital vein, that of the latter about one-third the distance from the apex to the second recurrent vein.

Legs light ferruginous, inner tibial spur distinctly stouter and longer; claws black, pectinate.

Abdomen of general color, strongly compressed, venter and apical segments slightly tinged with fuscous.

In redescribing this species I have examined the two cotypes.

Cotypes, two ♀'s, New York State Museum.

I am not fully satisfied of the validity of this species; it is related to *O. bifoveolatus* and its subspecies.

Distribution.—Colorado.

Ophion chilensis Spin.

Ophion chilensis Spinola, Gay Hist. fis. y. polit. de Chile, VI, p. 515, n. 1, ♀ .....1851.
" " Dalla Torre, Cat. Hym., III, p. 188.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 92.....1905.

Glaucous to light straw yellow, marked with ferruginous or black; vertex glaucous or luteous, antennæ fulvous, discocubital vein usually appendiculate, nervulus antefurcal to interstitial, nervellus broken at or near the middle.

Length, 12–18 mm.; wing, 12–15 mm.; spread, 26–32 mm.; antennæ, 12–18 mm.

Head luteous to alboglaucous, face sometimes tinged with ferruginous, vertex luteoglaucous; ocelli prominent, well separated; eyes medium sized, only slightly emarginate; clypeal foveæ distinct.

Thorax glaucous, mesonotum with three longitudinal ferruginous or black stripes, parapsidal furrows distinct only at the anterior border; mesosternum and metasternum ferruginous or dark gray, pleuræ of the general color, frequently marked with ferruginous, scutellum often flavous; metathorax more or less marked with fuscous or ferruginous, often in the shape of two clearly defined ferruginous spots at the base; with two transverse, two submedian and two lateral carinæ.

Wings hyaline, iridescent; stigma luteoglaucous, frequently marked with fuscous; costa light glaucous, with the lower edge black, nervures otherwise black; discocubital vein usually angularly broken and appendiculate, sometimes arcuate without appendix—first recurrent vein about one-third the length of the second; nervulus antefurcal to interstitial, nervellus broken at or near the middle.

Legs fulvous, coxæ frequently more or less glacous, claws pectinate; abdomen with first segment glacous or fulvous, the remainder varied with ferruginous or black, or entirely fuscous.

In redescribing this species I have examined twenty-five ♀ and one ♂ specimens.

Type.—♀. Location unknown to the author.

As Spinola notes in his description this species varies considerably in color in both directions, from a form with the body, except legs and antennæ, entirely glaucous to one that is straw-yellow with distinct ferruginous markings; between these two are various combinations of yellow and glaucous with more or less distinct ferruginous markings. The discocubital vein is normally angularly broken and appendiculate, but a good series shows at once that it is frequently, as in *bifoveolatus*, only angularly bent, or arcuate, and without appendix.

Distribution.—This species was described by Spinola from Chili, and I have before me numerous specimens from Largo Blanco Valle, Chubut Territory, Patagonia, Argentina.

Location of specimens.—U. S. National Museum, ♀ and ♂ from Argentina (Largo Blanco Valle, Chubut Territory, Patagonia). Massachusetts Agricultural College, ♀, Argentina. British Museum.

Ophion ancyloneura Cam.

Ophion ancyloneura Cameron, Biol. Centr. Amer., Hym., I, p. 294, n. 13, ♀, pl. 12, fig. 17.....1886.
" *ancyloneurus* Dalla Torre, Cat. Hym., III, p. 188.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 89.....1905.

Sulphur-yellow, antennæ, abdomen and tibiæ luteous, wings hyaline, stigma testaceous.

Length, 17 mm.

Antennæ a little longer than the body, pilose, third joint shorter than the fourth and fifth together; head closely punctured; clypeal foveæ large, deep, longer than broad, face broadly projecting in the middle; with a longish tubercle below the antennæ; tips of the mandibles piceous black. Thorax almost impunctate, shining; mesonotum with three obscure fuscous stripes, the sutures very shallow; metanotum with two distinct, transverse keels, united in the centre by two longitudinal ones, which form a longish area; from the apical transverse keel run some not very clearly defined keels to the apex, (except the central pair which form an area, narrower towards the apex in front of the above mentioned area between the two transverse keels);

petiole inclining to yellow, indistinctly keeled; post-petiole thicker than and clearly defined from the petiole, luteous, finely and closely punctured; the other segments are densely pilose, the apical one more darkly clouded. Wings hyaline, stigma testaceous, discocubital vein angularly broken and strongly appendiculate, nervulus antefurcal to interstitial.

I have not seen the type or a specimen of this species, and can only give the original description slightly rearranged.

Type.—Location unknown.*

Cameron adds: "Smaller than *O. flavo-orbitalis;* the head and thorax almost entirely yellow, the third joint of the antennæ longer, the first abdominal segment longer and narrower. The post petiole longer in proportion to the petiole: the second segment contracted before the middle (in addition to the contraction at the base), the third discoidal cellule distinctly angled in the middle, the projecting branch reaching just half way across."

I am not sure of the validity of this species, but it is closely related to *O. bilineatus.*

Distribution.—Guatemala, Capetillo.

Ophion bilineatus Say.

Ophion bilineatus Say, Contr. Maclur. Lyc. Arts Sci., p. 75, n. 1..1828.
" " " Boston Journ. Nat. Hist., I, p. 240, n. 4...1835.
" " " Compl. Wr. La Conte ed., I, p. 378, n. 1; II, p. 695, n. 4 (reprints, 1883, 1891).....1859.
" " Cresson, Proc. Ent. Soc. Phila., I, 206, Ind.....1862.
" " Norton, Proc. Ent. Soc. Phila., I, 358.....1863.
" " Sanborn, Mass. State Bd. Agr., Tenth Rept., p. 169.....1863.
" " Riley, Third Ann. Rept. Ins. Missouri, p. 69.....1871.
" " Cresson, Trans. Amer. Ent. Soc., IV, p. 169.....1873.
" " " Geog. Sur. Ter. Rept. Zool., 5, p. 706, Eastern Nevada.....1875.
" " Provancher, Nat Can., XXI, pp. 117–118, fig. 4.1879.
" " Packard, Bost. Soc. Nat. Hist. Proc., 21, p. 19..1882.
" *tityri* " Idem.....1882.
" *bilineatus* Saunders, Ins. Inj. to Fruits, p. 273, ♀ fig. 282 (second ed., 1889, third ed., 1909).....1883.
" " Provancher, Faun. Ent. Can., II, Hym., p. 351, n. 3, fig. 36, a, ♀ ♂.....1883.

* Not in the British Museum; it may have been deposited elsewhere or retained by Cameron.

Ophion bilineatus Lintner, Fourth Rept. Ins. N. Y., p. 205.....1888.
" " Howard, Scudder's Butterflies of Eastern U. S. (New Eng.), p. 1880, pl. 88, fig. 8.....1889.
" *tityri* Idem.....1889.
" *bilineatus* Riley and Howard, Insect Life, III, p. 155, list of hosts.....1890.
" " Ashmead, Colo. Biol. Assn. Bull., I, p. 43, Colo.1890.
" " Perkins, Vt. State Bd. Agr., Eleventh Rept., Sept., p. 18.....1890.
" *bilineatum* Ashmead, Smith. Cat. Ins. N. J., p. 15 (second ed., p. 580, 1899).....1890.
" " Harrington, Ent. Soc. Ont., Twenty-first Rept., p. 67.....1891.
" " Osborn, Partial Cat. Animals Ia., p. 115.....1892.
" " Evans, Can. Ent., 28, p. 10.....1896.
" " Howard, U. S. Dept. Agr., Div. Ent., Bull. 5, Tech. Ser., p. 30.....1897.
" " Dalla Torre, Cat. Hym., III, p. 188, Am. bor..1901.
" *tityri* Idem, p. 198.....1901.
" *bilineatum* Ashmead, Proc. Wash. Acad. Sci., IV, p. 233, Sitka, Alaska, two ♀'s, June 16.....1902.
" " Felt, N. Y. State Mus., Bull. 76, p. 114, pl 2, fig. 3.....1904.
" *tityri* Idem, p. 116.....1904.
" *bilineatum* Ashmead, Hym. of Alaska, p. 239, two ♀'s, Sitka, Alaska, June 16.....1904.
" " Howard, Insect Book, pp. 60½, pl. 10, n. 17.....1905.
" " Viereck, Trans. Kansas Acad. Sci., XIX, p. 313, taken at 3350 feet.....1905.
" *idoneum* Idem.
" *bilineatus* Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 114.....1905.
" *tityri* Szepligeti, Idem, p. 32, n. 122.....1905.
" *bilineatus* Hitchings, Third Rept. Maine State Ent., p. 12.....1908.
" *tityri* Chittenden and Russell, U. S. Dept. Agr., Bur. Ent., Bull. 66, Part V, p. 63.....1909.
" " Viereck, Smith's Ins. N. J., third ed., p. 621.....1910.
" *bilineatus* Viereck, Idem.....1910.
" *latilineatus* Cameron, Journ. Royal Agr. and Commer. Soc. Brit. Guiana, p. 179.....1911.

Fulvo-ferruginous, varying from flavous to ferruginous; eyes large, extending nearly to the base of the mandibles, abdomen usually strongly compressed, stigma well developed, discocubital vein appendiculate, size variable.

Length, 10–20 mm.; wing, 9–18 mm.; spread, 20–38 mm.; antennæ, 14–22 mm.

Fulvo-ferruginous, varying from flavous to ferruginous, the light specimens usually with dark ferruginous markings.

Head with dorsal and posterior aspects yellowish, frequently with irregular narrow bands of yellow surrounding the eyes and writing behind the ocelli; antennæ as long or longer than the body; ocelli large, well separated, the posterior a little distant from the tops of the eyes; eyes large, emarginate; clypeal foveæ distinct; mandibles bidentate, tipped with black.

Thorax slightly lighter colored than the rest of the body; mesonotum with three longitudinal ferruginous stripes more or less distinct; metathorax with inconstant carinæ, or smooth and finely punctured; two transverse and six longitudinal carinæ are frequently evident, but are often more or less indistinct and sometimes entirely wanting.

Wings hyaline, often slightly tinged with fuscous; iridescent, stigma and most of the costa flavous,* nervures otherwise black; discocubital vein angularly broken and appendiculate, the appendix varying considerably in length; nervulus antefurcal to interstitial, nervellus broken at or near the middle, a small glabrous spot in the discocubital cell near the stigma; legs of the general color, claws pectinate; abdomen generally strongly compressed, often darker at the apex, varying somewhat in shape, slender or quite broad.

In describing this species I have examined over 500 specimens from all parts of North America, the West Indies, and some from South America.

Type.—Lost.

This species shows a wide variation in color, and light and dark specimens are common; Say's type must have been one of the light forms, many of which are more or less distinctly marked with longitudinal ferruginous stripes on the mesonotum. Sometimes the stripes are lacking even in the lighter forms, while in the dark forms the whole thorax is ferruginous, and the mesonotal stripes are consequently obliterated. Between these two light and dark forms are all sorts of gradations. The wings are normally hyaline but are often tinged with fuscous; the length of the appendix of the discocubital vein varies from almost rudimentary to long; the areolation of the metathorax varies considerably, it being sometimes smooth, without carinæ, and sometimes strongly

* The stigma is sometimes marked with ferruginous or black.

areolated as described, but more frequently an intermediate condition exists where the carinæ are present but more or less indistinct. In all parts of the range of this species there are a few small specimens; these seem to be especially numerous in Colorado, and might at first be looked upon as a separate species or subspecies, but since they agree with the larger specimens in structure and color, and show the same variations, I do not see how they can be considered even a subspecies. *O. tityri* Pack. was at first proposed as a variety of this species, and later raised to specific rank, the differences given being that *tityri* is "smaller, with the abdomen considerably shorter, the metathorax strongly areolated, and the male clasps subtriangular, obtusely rounded; while in *bilineatus* the metathorax is smooth, and the male clasps are subtriangular, obliquely truncate and acute posteriorly." After a careful examination of a large series, however, I find that none of these characteristics are constant. I have worked upon these for some time, and do not believe *tityri* can be given even subspecific rank. Occasionally characteristic *tityri* specimens will be found, but there is a complete gradation from these to the typical *bilineatus*, and these intermediate specimens are by far the most abundant. Dr. Felt states that *tityri* "has a well-defined period of flight, which does not overlap the time *O. bilineatus* is abroad, except in the case of scattering individuals. This species appears early in May, is most abundant till the latter part of the month and occasionally in July, with belated individuals to October, while *O. bilineatus* does not occur till August, and then only in scattering numbers till the latter part of the month. This marked difference in the time of flight between these two parasites indicates either that they represent two broods of the same insect or else they are distinct species." Specimens before me, however, show that characteristic *bilineatus* are taken quite as frequently early in the summer, and I have taken them at Amherst, Mass., as early as April 15. Many of the more slender specimens closely resemble *O. luteus*, and some writers have considered the South American forms as such, believing it to be introduced. After examining

such specimens and comparing them with authentic specimens of *luteus* from Europe I find little difference, and *bilineatus* may prove to be a synonym or subspecies of *luteus*. However, until a good series of both can be compared the two species should be preserved.

Distribution.—This species has a wide distribution from Alaska and southern Canada to Patagonia, Argentina, including the West Indies. In North America it has been taken on the north at Sitka, Alaska; Lake Winnipeg; Sudbury, Ontario; and Grand Lake, Newfoundland. In the United States it has been taken in nearly every State from Maine, Ohio, Montana and Washington, to Florida, Texas and California. I have also seen specimens from Mexico; British Honduras; Porto Rico; Santo Domingo; Jamaica; Bonito Province, Pernambuco, Brazil; Chili; Tapis and Chubut, Patagonia, Argentina.

Life history and habits.—This species is, next to the long-tailed and purged Ophions, the most common in collections and the one most frequently noted in entomological literature. Yet very little is recorded concerning the life history and habits of the species. Adults have been taken in Massachusetts from April 15 to the last of October, but appear to be most abundant from the middle of May to the first of September. The Cornell experiments with trap-lanterns seem to show that there are two broods, one the last of May and one in August, with only scattering specimens during the intervening months. But as much of the museum material is without date of capture I am unable to decide this question. Toward the south adults will probably appear earlier and later, and I have before me specimens from Bonito Province, Brazil, taken January 31, Febuary 4 and August 1, and from Santo Domingo, West Indies, in September. The large eyes indicate crepuscular or nocturnal habits, and experiments show that it is one of the most abundant forms attracted to light. The females are, as might be expected, more abundant in collections owing to their activity in searching out suitable hosts for their eggs. The

Cornell lantern records show that eighty-seven males were to taken four and five females. This species does not appear always to spin a cocoon, due probably to the conditions obtaining; if the larva can pupate within the cocoon of its host no cocoon of its own is necessary, but if the host dies before it can spin up, the larva of the parasite evidently spins a cocoon. This is compressed oval, 15–16 mm. long and 5–8 mm. wide, composed of dull, dirt-colored silk, sometimes darker at the ends and thus forming a more or less distinct median band.

Economic importance.—Very little is known of the hosts of this species, and hence its value as a parasite can not be determined, but its abundance and wide distribution indicate that it is important. The brief records available show that it preys on some of the Arctians and Noctuidæ; the former are not of much economic importance, but the latter are, and this species may accordingly prove to be of considerable value.

The following hosts have been recorded, or specimens are before me:

Diacrisia (*Spilosoma*) *virginica* Fabr., Felt, N. Y. State Mus., Bull. 76, p. 115 .....1904.
Epargyrus tityrus Fabr., Idem.
Feltia gladiaria (*morrisoniana*) Morrison; Riley and Howard, Ins. Life, III, p. 155.....1890.
Glæa inulta, Grote, Idem.
Halisidota caryæ Harris; Felt, N. Y. State Mus., Bull. 76, p. 118 .....1904.
? *Notolophus leucostigma* Abb. and Smith; Howard, U. S. Dept. Agr., Div. Ent., Tech. Ser., Bull. 5, p. 30 ....1897.
Prodenia eridania Cram.
Samia cecropia L.
Symmerista albifrons Abb. and Sm.; Felt, N. Y. State Mus., Bull. 76, p. 118.....1904.
Telea polyphemus Cram., July 17–Aug. 1.

Location of specimens.—The U. S. National Museum collection contains specimens from Sitka, Alaska; British Columbia, Washington, California, Wyoming, Montana, Colorado, Michigan, Kansas, Arkansas, Indiana, Ohio, Pennsylvania, New York, Connecticut, New Hampshire, Delaware and Virginia.

Ophion biangularis Tasch.

Ophion biangularis Tasch., Zeitschr. ges. Nat., Vol. XLVI, p. 432, Lagoa Santa, Brazil, ♀ .....1875.
" " Dalla Torre, Cat. Hym., III, p. 188, listed.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 91, listed.....1806.

Testaceous with head much paler, apex of abdomen infuscated; melanotum areolated. Wings hyaline, stigma fuscous, base of wings and squamula testaceous.

Length, 16 mm.

Weakly pubescent. The metanotum is divided by two ridges into three equal stripes; through the middle and hind areas goes, divided by two longitudinal ridges, a somewhat wedge-shaped, narrow, longitudinal area. On the clear wings the insipid yellow stigma and background stand out sharply against the dark veins. The hind border of the large cell is broken in the middle nearly at right angles and furnished with a nerve branch, then in the middle of its outer part nearly broken again by a very blunt angle. The inner part of the radius is straight.

I have seen only one specimen of this species.

Type.— ♀. Location unknown.

Distribution.—Lagoa Santa, Brazil; Cordoba, Mexico; one ♂ U. S. National Museum, Cordoba, Vera Cruz, Mexico (March 26, 1908).

Ophion abnormis Felt.

Ophion abnormum Felt, N. Y. State Mus., Bull. 76 (nineteenth Reprt. State Ent.), p. 121, pl. 2, n. 5.....1904.
Eremotylus felti Viereck, Kans. Acad. Sci., XIX, p. 264.....1905.

Flavofulvous varied with ferruginous; head large, face broad; eyes small, distant from base of mandibles; discocubital vein with more or less distinct appendix; sometimes with an abnormal stub of a vein extending back into the third discoidal cell.

Length, 13–18 mm.; wing, 12–15 mm.; spread, 26–32 mm.; antennæ, 12–17 mm.

Head flavous tinged with fulvous, large, broad; eyes small, narrow, only slightly emarginate, distant from the base of the mandibles; ocelli large, prominent, well separated, distant from the tops of the eyes; antennæ fulvous, short, not quite as long as the body; face broad, clypeal foveæ deep; mandibles strong, bidentate, tipped with black; thorax flavofulvous marked with ferruginous; mesonotum with three longitudinal ferruginous stripes; parapsidal furrows distinct only in front; scutellum small, rounded, often flavous; pleuræ more or less

and pectus generally ferruginous; metathorax shining, smooth and finely punctured, with indistinct carinæ.

Wings hyaline or slightly tinged with fuscous; stigma light to dark flavous; nervures black; discocubital vein angularly bent without an appendix, or angularly broken with a more or less distinct appendix; rarely with an abnormal stub of a vein extending back into the third discoidal cell; nervulus interstitial to postfurcal, nervellus broken at or above the middle.

Legs fulvous; claws pectinate.

Abdomen fulvous, sometimes marked with fuscous, especially along the venter; usually strongly compressed.

Redescribed from type ♀ and eight ♂ specimens.

Type.— ♀. New York State Museum.

This species is closely related to *O. bifoveolatus*, but may be recognized by the larger, usually flavous head, which is generally fulvous in *bifoveolatus*—the usually more strongly compressed abdomen and smaller size. In the type there is a stub of a vein projecting into the third discoidal cell from the lower half of the discocubital vein, but this is apparently abnormal, for there was never any recognized vein at this place, and a homotype in the collection of the American Entomological Society shows this abnormality in only one wing and located slightly lower down. The appendix and discocubital vein vary as in *bifoveolatus*.

After carefully examining one of Viereck's paratypes of *Eremotylus felti* Vier., in the American Entomological Society collection I find that it belongs in the Genus *Ophion*, and after comparing it with specimens of *O. abnormis* I believe that it is a synonym. In the paratype of *E. felti* the base of the radial vein is slender and straight, not thickened and bent as in *Eremotylus;* the discocubital vein is bent as in many specimens of *O. bifoveolatus*, and the third discoidal cell is short and high—not long and slender as in *Eremotylus*. A series of specimens shows that the discocubital vein varies, as in *bifoveolatus*, from angularly bent and without appendix to angularly broken and more or less strongly appendiculate.

Distribution.—Washington, Montana, California, Colorado, Kansas.

This species seems to have a limited range through the west-

ern United States following the Rocky Mountains and Coast Range. The type was taken in Colorado, and Viereck's specimens came from Denver, Colo., and Hamilton County, Kansas, at 3,350 feet. I have before me specimens from Cheney, etc., Wash.; Palo Alto, Cal., March 25; Missoula, Mont., May 18; and several specimens from Colorado.

Nothing is known of the life history, habits, or hosts, but these probably differ little from those of *bifoveolatus*. The small eyes indicate that it may be diurnal.

Location of specimens.—New York State Museum, ♀ type. American Entomological Society, homotype, ♂, Colorado; ♀, Paratype of *E. felti* Vier., Denver, Colo.; three ♂'s, southern California. Washington, U. S. National Museum, two ♂'s, Cheney, Wash., and Riley, Colo. Kansas University, ♀ (type of *E. felti* Vier.), 3,350 feet, Hamilton County, Kans. Montana Agricultural College, ♂, Missoula, Mont., May 18. Leland Stanford, Jr., University, Palo Alto, Cal., March, 25.

Ophion flavoorbitalis Cam.

Ophion flavoorbitalis Cameron, Biol. Centr. Amer., Hym., I, p. 294, pl. 12, fig. 16.....1886.
" " Dalla Torre, Cat. Hym., III, p. 191.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 101.....1905.

Luteous, eyes and scutellum flavous, wings hyaline, stigma luteous. Length, 21–22 mm.

Face broadly projecting, finely punctured; thorax finely punctured, scutellum with the side carinate; metanotum aciculate, with two short transverse keels, the space between them hollowed; a longitudinal keel on either side of these, and a posterior transverse one forming a longish area; wings hyaline, stigma luteous, discocubital vein angularly broken and appendiculate, its outer half parallel with the basal half of the radial vein.

First abdominal segment dilated at the apex, the dilation gradual from the middle; the sides keeled; second segment thicker and distinctly shorter than the first.

I have not seen the type or a specimen of this species and can only give the original description, slightly modified.

Type.—♀. British Museum.

I am not sure of the validity of this species, and it may

yet prove to be a synonym of *O. bilineatus;* it may apparently be recognized by its lighter color and broadly projecting face. The third discoidal cell is, judging from the figure, fully as wide as long.

Distribution. — Mexico (Cordova), Panama (Volcan de Chiriqui, 2,500 to 4,000 feet.

Ophion chiriquensis Cam.

Ophion chiriquensis Cameron, Biol. Centr. Amer., Hym., p. 294, n. 11, pl. 12, fig. 20.....1886.
" " Dalla Torre, Cat. Hym., III, p. 188.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 93.....1905.

Luteous, head, scutellum and pleura flavous, wings hyaline, stigma luteous.

Length, 23 mm.

Head shining, obscurely punctured; antennæ luteous, as long as or longer than the body; clypeal foveæ deep, longish.

Thorax covered with close pale pubescence; mesonotum very minutely punctured, the pleura finely, longitudinally striated. Scutellum carinate along the sides. Metanotum with one transverse keel near the base, the base behind it finely rugose, the rest of the surface finely rugose and bearing arcuate keels; metapleuræ finely rugose; petiole shining, glabrous, slightly hollowed in the center above the base; second segment stouter and not so much compressed laterally as the petiole, densely covered with a white pubescence. Wings hyaline, stigma luteous, basal division of the radius not curved upward, third discoidal cell more than three times as long as wide, nervulus antefurcal.

I have not seen a specimen of this species, and can only give the original description slightly rearranged.

Type.— ♀. British Museum.

Cameron states that it is "smaller than *O. curvinervis* and identical with it in structure (including the form of the metathorax) and in coloration, except that the antennæ are entirely luteous; differing from it otherwise in its smaller size, in the second abdominal segment being stouter and not so much compressed laterally compared to the first; in the basal division of the radial nervure not being curved upwards, and in the upper angles of the apex of the first cubital cellule being longer than the lower."

Distribution.—Panama, Volcan de Chiriqui, 2,000 to 3,000 feet.

Genus **RETANISIA** Cam.

Retanisia Cameron, Biol. Centr. Amer., Hym., I, p. 299.....1886.
" Ashmead, Proc. U. S. Nat. Mus., No. 1206, pp. 87, 184 (Vol. XXIII, 1900).....1900.
" Dalla Torre, Cat. Hym., III, p. 179.....1901.
" Szepligeti, Gen. Ins., Hym., 34me Fasc., pp. 36–37.....1905.

Parapsidal furrows deep; claws not pectinate; abdomen not much longer than the head and thorax together, gradually dilated to the fifth segment; discocubital cell receiving both recurrent veins; median tibiæ with two apical spurs; antennæ long, filiform.

Generic type *R. facialis* Cam. (monotypical).

Cameron characterizes the genus as follows:

"Head as broad as the mesonotum, about one-half broader than long. Clypeus almost transverse at the apex, but with the sides rounded; labrum small, rounded. Eyes not incised on the inner side. Parapsidal furrows deep and wide, reaching nearly to the scutellar fovea, which is wide and deep. Scutellum longer than broad, not much elevated, narrowed toward the apex, which is rounded; the sides are keeled. Metathorax gradually sloping to the apex, longish, with more or less distinct areæ. Abdomen not very much longer than the head and thorax united, becoming gradually dilated to the fifth segment. Hind legs very long; the coxæ longer than the trochanters, the tibiæ nearly as long as the coxæ, trochanters and femora united; the tarsi a little shorter than the tibiæ; the hind tibiæ having two short thick spurs, the anterior pair a longer and more curved one. The matatarsus is scarcely twice the length of the next joint, and the basal joint of the anterior tarsi is curved at the base. In this genus the cubital cell receives both the recurrent nervures, and therefore agrees with *Thyreodon*, *Ophion*, *Nototrachys*, *Ophiopterus* and *Agathophiona*. From *Thyreodon* it may be known by the abdomen not being strongly compressed laterally, the much longer legs and antennæ, the eyes entire and the claws not pectinated; from *Nototrachys* by the long antennæ and the shining mesonotum; from *Ophion* by the abdomen not being compressed, the eyes entire, and the now pectinated claws; from *Ophiopterus* by the very long antennæ and legs, and the dilated abdomen; and from *Agathophiona* by the normal length of the labium, the long antennæ, the much longer legs, and the much shorter, more dilated and thickened abdomen; and from all five by the very deep parapsidal furrows, The antennæ in the male—the only sex known—are longer than the body; the joints contracted in the middle, dilated at the base and apex; the third joint about one-fourth longer than the succeeding ones; towards the apex the joints become very slightly narrowed."

Judging from Cameron's plate the nervulus is interstitial and the nervellus broken at the middle, the discocubital vein arcuate, not appendiculate. I am not sure of the validity of this genus, for the short stout abdomen of the male—the sex of the single specimen known—indicates that the female when discovered may have a long ovipositor or other characters which might place it in some other genus. As I have not seen a specimen, however, I have preserved the genus, but further investigation is necessary.

Distribution.—Guatemala (Purula).

Nothing is known of the life history, habits or hosts.

Retanisia facialis Cam.

Retanisia facialis Cameron, Biol. Centr. Amer., Hym., I, p. 299, n. 1, ♂, pl. 12, fig. 7.....1886.
" " Dalla Torre, Cat. Hym., III, p. 179.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 37.1905.

Black, scape of antennæ beneath, face, mouth, eyes, anterior feet in part and apex of posterior tarsi flavous; wings hyaline, apex smoky, nervures black, ♂.

Length 15 mm. (about).

Head strongly punctured; a triangular projection below the antennæ, its centre almost carinated, the face transversely striated on either side of it; below the antennæ, the orbits broadly behind, the palpi, ciypeus (except at the extreme apex), and the labrum yellow. Thorax strongly punctured, shining, the scutellum scarcely so strongly punctured as the mesonotum; metanotum with seven areæ; the sides more or less reticulated. Abdomen shining, impunctate, the ventral surface in the middle obscure yellow. The anterior legs in front and the tarsi are entirely yellow; the middle pair have the coxæ, the greater part of the trochanters, the femora—except the base—and the apices of the tarsi, yellow; the four apical joints of the hind tarsi are also yellow. The head and thorax are covered with a close fuscous pile.

Distribution.—Guatemala (Purula).

Nothing is known of the life history, habits or hosts.

Genus **ENICOSPILUS** Steph.

Enicospilus Stephens, Cat. Brit. Ins., p. 352 (nomen nudum).....1829.
" " Illustr. Brit. Ent. Mand., VII, p. 126, pl. 40, fig. 4.....1835.
" Westwood, Brit. Ent., I, Appendix, p. 60.....1840.
" Stephens, Illustr. Brit. Ent. Mand., VII, p. 311.....1845.
" " Idem, Suppl., p. 3.....1846.
" Kirchner, Cat. Hym. Europ., p. 99.....1867.

Allocamptus Förster, Verh. Nat. preuss. Rheinl., 25, p. 150 (Nec Thomson).....1868.
Henicospilus Bridgman and Fitch, The Entomologist, 17, p. 176..1884.
Dispilus Kriechbaumer, Berl. Ent. Zeitschr., 39, p. 309.....1894.
Enicospilus Ashmead, Proc. U. S. Nat. Mus., No. 1206, pp. 87, 170 (Vol. XXIII).....1900.
" " Trans. Ent. Soc. Lond., pp. 270, 354.....1900.
Trispilus Kriechbaumer, Zeitschr. Syst. Hym. Dipt., I, p. 156 ...1901.
Pterospilus Kriechbaumer, Idem.....1901.
Henicospilus Dalla Torre, Cat. Hym., III, p. 180.....1901.
Enicospilus Felt, N. Y. State Mus., Bull. 76, pp. 101, 107 (nineteenth Rept. State Ent.).....1903.
Henicospilus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 7..1905.
" Schulz, Spolia Hym., p. 277.....1906.
Eniscospilus Schmiedeknecht, Opusc. Ichn., 18, p. 1428, n. 4.....1908

Anterior wings without areolet; discocubital vein not angularly broken but straight or bent, not appendiculate; transverse-cubital vein straight, discocubital with one or more chitinous maculæ in a glabrous area; face unarmed, clypeus truncate. Ocelli large, claws long and pectinate.

Generic type.—E. merdarius Grav.

The chief generic characters of this genus lie in the wings and the members resemble representatives of the Genus *Eremotylus* in many respects. The venation is similar in the characteristic shape of the radial and discocubital veins, the only important difference being in the presence of maculæ in *Enicospilus*. Just how constant these are can not be determined from data now available, but it is evident that the size and shape of a macula often varies somewhat and may be entirely lacking. This occurs in such species as *purgatus* and *thoracicus*, and it is certainly possible that it may occur in such species as *flavus* and *flavo-scutellatus*. If the single macula in the last should be entirely lacking a specimen would be readily classed in the Genus *Eremotylus*. Numerous records indicate and study of a good series of specimens quickly shows, that the shape and size of the maculæ vary considerably within a species, and that apparently little weight can be placed upon these characters. Just how great this variation is can not be determined until extensive breeding experiments have been carried on.

The Genus *Enicospilus* was first proposed by Stephens in his Catalogue of British Insects, p. 352, 1829—with a single species, *E. simulator ;* no description of *E. simulator* can be found and it evidently never passed the manuscript stage. Both genus and species, being new and without descriptions, stand as nomina nuda. In 1835 the Genus *Enicospilus* was again proposed in Stephens' Illustrations of British Entomology, Mandibulata, VII, September 30, p. 126, and this time it was characterized in a table. A colored figure, by Westwood, was given on a plate stamped "Published Sept. 30, 1835," but it seems to have been published in the part* dated October 31, 1835, and so far as I can learn no name or description was given to this figure till the part published November, 1845,† when it was given in the list of plates as *Enicospilus merdarius* Grav.‡

This was a well-known species of *Ophion* described in 1829' and as a species is thus designated, the genus *Enicospilus* Stephens must stand as established in November, 1845, with *Enicospilus merdarius* Grav. as type. It is evident that the figure—Pl. 40, fig. 4—is not *merdarius*, and Stephens recognized his mistake when he published the description—Suppl., Aug., 1846—of *E. merdarius*, *ramidulus* and *combustus*, and stated that the figure is *E. combustus* Grav. The figure differs markedly from the description of *E. merdarius* but agrees with that of *E. combustus*, and must stand as such. This fact does not, however, affect the validity of *E. merdarius* Grav. as generic type. Ashmead for some reason unknown to me credits this genus to Curtis.

Orthography.—Considerable confusion has arisen over the orthography of the generic name, and it has been spelled *Enicospilus*, *Henicospilus* and *Eniscopilus*. This confusion is partly due to the derivation of the name—from ἑνῐκός, unicus ; σπίλος, macula. Stephens spelled the name *Enicospilus*, but apparently overlooked the aspirate ἑ which would make the

* Stephens' Illustr. Brit. Ent. was published serially.

† Westwood states, Brit. Ent., I, Appendix, p. 60, in 1840, that this figure, plate 40, fig. 4, is evidently intended for a species of the Genus *Enicospilus*, of which the species is not indicated.

‡ Gravenhorst, Ichn. Europ., III, p. 698, n. 138, ♀ ♂, 1829.

derivative *Henicospilus*. Some later writers have tried to remedy his seeming mistake by adding the *H*, hence the confusion. According to the International Code of Nomenclature — Art. 19 — "The original orthography of a name is to be preserved unless an *error of transcription*, a *lapsus calami*, or a *typographical error* is evident." In this case an error of *transliteration* is evident, not an error of transcription. Both a *lapsus calami* and a *typographical error* are excluded, for Stephens wrote *Enicospilus* consistently in several places and at different times, namely, in his Catalogue of British Insects, p. 352, 1829, in his Illustrations of British Entomology, Mandibulata, VII, p. 126, September, 1835; List of Plates, November, 1845, and in the Supplement, p. 3, August, 1846.

The question rests, therefore, upon the interpretation of the word transcription, and I do not believe it can be made to include transliteration,* The latter corrections can not, therefore, be accepted, and the generic name stands as *Enicospilus* Stephens, established November, 1845; type *Enicospilus merdarius* Grav.

Distribution.—Most members of this genus are tropical or subtropical, but a few range into the Boreal Zone, representatives of the genus having been taken from Alaska and Newfoundland in North America to Buenos Ayres in South America, including the West Indies.

Enicospilus purgatus has a remarkable distribution, specimens before me showing that it ranges from Fox Point, Alaska,† and Grand Lake, Newfoundland, south into Mexico, the West Indies and Chili. No other member of the genus is known to be so widely distributed. Among the tropical forms *monticola* has been taken 3,000 feet above sea level and *flavoscutellatus* at 4,500–7,000 feet, but whether these species are local or have followed the mountain ranges is not yet determined.

* For further discussion of emendation of names, see U. S. Dept. Agr., Bur. Animal Ind., Bull. 79, pp. 75–76, 1905.

† "An Indian village at the extreme southeastern corner of the Alaska mainland."

Economic importance.—Not much is known of the life histories of the tropical species, but the northern members are recognized as beneficial parasites. Records indicate that *E. purgatus* is one of the most valuable members of the tribe since it preys upon several injurious insects of considerable importance. It has been frequently noticed as a parasite of the destructive army worm, *Heliophila unipuncta* Haw., on which it "serves as a very efficient check." Professor Luggar's report of 1896 gives the best evidence of its value as a parasite. I have before me one specimen bred from the cotton worm (*Aletia*) *Alabama argillacea*, but can find no record of this host, and can not say whether or not it is frequently attacked. It has also been reared from the zebra caterpillar, *Mamestra picta* Haw., another injurious species, and preys upon several of less importance.

Life history and habits.—Little is known of the life history or habits of the members of this genus aside from those of *E. purgatus*, but so far as known they do not differ from those of other members of the tribe.

Table of Species.

1. Antennæ black or dark fuscous.....2.
   Antennæ flavous or fulvoferruginous.....9.
2. Abdomen entirely black beyond the first segment.....3.
   Abdomen not entirely black beyond the first segment.....4.
3. Larger macula appendiculate.
   fuscipennis flavostigma n. subsp.
   Larger macula not appendiculate.....**fuscipennis** Szep.
4. Wings fulvo-hyaline.....**bicolor** Tasch.
   Wings hyaline.....5.
5. Head with distinct longish tubercle below the antennæ.
   fuscicornis Cam.
   Head without distinct longish tubercle below the antennæ.....6.
6. Discocubital cell with one macula.....7.
   Discocubital cell with two maculæ.....8.
7. Discocubital cell with a linear, arcuate macula...**nigricornis** Br.
   Discocubital cell with a triangular macula.....**cressoni** n. sp.
8. Abdomen beyond the fourth segment black.....**fernaldi** n. sp.
   Abdomen with segments 3 to 8 black .....**monticola** Cam.
9. Discocubital cell with only one macula or a macula and one or more lines.....10.
   Discocubital cell with more than one macula .....19.

10. Vertex yellow....11.
Vertex black....16.
11. Apex of abdomen black....12.
Apex of abdomen not black....13.
12. Discocubital cell with one macula....**nigricauda** Tasch.
Discocubital cell with one macula and two lines.
thoracicus Cress.
13. Stigma red....**flavoscutellatus** Br.
Stigma yellow....14.
14. Discocubital cell with one macula and two lines..**thoracicus** Cr.
Discocubital cell with one macula....15.
15. Stigma pale flavous....**guatemalensis** Cam.
Stigma fulvous....**neotropicus** n. sp.
16. Abdomen entirely red....**brullei.**
Abdomen not entirely red....17.
17. Abdomen with three basal segments red, the rest yellow.
trilineatus Br.
Abdomen with three basal segments yellow....18.
18. Larger macula with outer end sharply pointed....**flavus** Fabr.
Larger macula with outer end rounded....**concolor** Cress.
19. Larger macula appendiculate....20.
Larger macula not appendiculate....22.
20. Discocubital cell with two maculæ, the larger with a long appendix extending below the smaller....**purgatus arcuatus** Felt.
Larger macula with only a short appendix....21.
21. Sternum and stigma (except base and apex) black.
maculipennis Cress.
Sternum and stigma yellow....23.
22. Face with distinct median tubercle between the antennal fossæ.
sphacelatus Erich.
Face without distinct median tubercle between the antennal fossæ....26.
23. Discocubital cell with two maculæ and often a line—the detached appendix of the larger macula—under the smaller.
purgatus Say.
Discocubital cell with only two maculæ....24.
24. Outer macula erect crescentic....25.
Outer macula not erect crescentic....**concolor** Cress.
25. Outer macula with horns pointed towards the apex of the wing.
cubensis Nort.
Outer macula with horns pointed towards the body.
fernaldi n. sp.
26. Smaller macula erect crescentic....**cubensis** Nort.
Smaller macula not erect crescentic....27.
27. Abdomen yellow....**purgatus** Say.
Abdomen not yellow....**flaviceps** Br.

Enicospilus fuscipennis flavostigma n. subsp.

Similar to *fuscipennis* except that the stigma is flavous, the larger macula appendiculate, and the metathorax has a weak median longitudinal keel.

Described from one female specimen.

Type.— ♀. U. S. National Museum.

Distribution.—Cayenne, French Guiana.

Enicospilus guatemalensis Cameron.

Ophion (*Enicospilus*) *guatemalensis* Cameron, Biol. Centr. Amer., Hym., I, p. 293, n. 9, ♀, pl. 12, fig. 22.....1886.

Henicospilus guatemalensis Dalla Torre, Cat. Hym., III, p. 182, listed Guatemala.....1901.

" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 59, listed.....1905.

Pale flavous, vertex yellow, wings hyaline, stigma pale flavous, discocubital cell with one subtriangular horny macula.

Length, 18 mm.

Body flavous, unicolorous; vertex flavous.

Thorax with scutellum more gibbous than in *E. concolor*, not so narrowed behind, scarcely keeled at the sides and not punctured, but finely striated at the apex; metanotum without median keel; wings hyaline; the third discoidal cellule not so dilated at the apical half as in *concolor;* discocubital cell with only one pear-shaped macula; nervulus interstitial.

In the unicolorous body this species agrees with *E. concolor* but is much smaller and the color more dilute in tint; *E. flavus* may be known from this species by the deeper fulvous tint of the body, by the middle of the vertex being black and the mesonotum punctured; the metanotum is much more strongly wrinkled and the macula of the discocubital cell more strongly pointed at the apex.

I have not seen a specimen of this species, and am not sure of its identity, but it appears to be closely related to *E. purgatus.*

Type.— ♀. British Museum.

Distribution.—San Gerónimo, Guatemala.

Enicospilus fuscipennis Szep.

Henicospilus fuscipennis Szepligeti, Ann. Hist. Nat. Mus. Nationalis Hung., IV, Part I, p. 147, ♀.....1906.

" *persimilis* Szepligeti, Idem, p. 147, ♂.....1906.

Fulvous; vertex, antennæ, stigma and abdomen beyond the second segment black; discocubital cell with two maculæ.

Length, 19–25 mm.; wing, 14–16 mm.; spread, 30–34 mm.; antennæ, 20–26 mm.

Head flavous; vertex and antennæ black; antennæ as long as or longer than the body; ocelli large, well separated, the posterior close to the tops of the eyes; eyes large, emarginate; face sometimes with a more or less distinct median black band, running from the anterior ocellus to or below the antennal fossæ,

Thorax dull fulvous; mesonotum indistinctly tinged with fuscous; mesopleuræ smooth; scutellum with lateral keels; metathorax with strong anterior transverse carina, in front of which it is smooth, behind with arcuate wrinkles.

Wings slightly tinged with fulvous or light brown, stigma and nervures fuscous to black; discocubital cell with two maculæ, the larger triangular, not appendiculate, the smaller round, or slightly elongate, nervulus antefurcal, nervellus broken below the middle, discocubital vein bent, the first recurrent vein two-thirds the length of the second.

Legs fulvous, claws pectinate.

Abdomen with the two basal segments fulvo-ferruginous, beyond the second segment black, the lower apical corner tinged with fulvous.

In redescribing this species I have compared two female specimens with the original description.

Type.—♀. Hungarian National Museum.

This species shows some variation in color and shape of the maculæ as in other species; the smaller macula may be circular or almost linear, and the wings vary from hyaline with only a slight fulvous tinge to light brown. Szepligeti has based a new species—*persimilis*—on these two differences, but specimens before me show that they are variable. His specimens with finely rugose metathorax are only minor variations.

Distribution.—This species has a fairly wide range through Peru, Bolivia and Brazil, and probably north into Venezula. Szepligeti's types came from Mapiri, Bolivia, and Minas Geraes and Blumenau, Brazil, and his other specimen, the type of *persimilis*, from Pachitea, Peru, while I have seen specimens from Peru.

Nothing is known of the life history or habits.

Location of specimens.—Hungarian National Museum. Type ♀; also type ♂ *persimilis*. U. S. National Museum, two ♀'s, Peru.

Enicospilus bicolor Tasch.

Ophion bicolor Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 434, n. 19, ♀.....1875.
" " Dalla Torre, Cat. Hym., III, p. 188.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 53.....1905.

Testaceous, antennæ and apex of abdomen black, wings flavo-hyaline, with two horny maculæ, the larger cordate, appendiculate, the smaller crescentic.

Length, 24 mm.

Head testaceous, antennæ and eyes black; thorax uniformly shell-yellow, somewhat sericeous, especially the weak metathorax; the anterior transverse carina of the metathorax not uniting with the lateral carinæ but running out before reaching them; the surface finely rugose.

Wings tinged with fulvous, the discocubital cell with two maculæ, the larger heart-shaped with an arcuate continuation extending along the border of the glabrous area, in the middle of which the pale crescent-shaped smaller macula stands upright.

Abdomen with the three basal segments shell-yellow; the fourth has only a lateral spot of this color at the base, and the rest only a reflection on the outer lateral angle, otherwise black.

I have not seen a specimen of this species, and can only give a free translation of Taschenberg's description.

Type.—♀. Nova Friburgo, Brazil; location unknown.

Taschenberg considered this species as "standing very near *E. nigricornis* Br. in color and shape of the maculæ, but could not call its color rufous," as in the latter, he "also found the color of the abdomen different, and the angle which the second recurrent vein forms with the outer edge of the large cell is certainly more blunt than in *E. nigricornis;* if even its sides are the same." As *E. nigricornis* Br. has only a linear, oblong macula, the two should not be confused.

Distribution.—Nova Friburgo, Brazil.

Enicospilus fuscicornis Cam.

? *Ophion sphacelatus* Erichson, Schomburg's Reisen in British Guiana, Part III, p. 587.....1848.
" (*Enicospilus*) *fuscicornis* Cameron, Biol. Centr. Amer., Hym., I, p. 291, n. 8, ♀.....1886.
Henicospilus fuscicornis Dalla Torre, Cat. Hym., III, p. 182.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 58.....1905.

Rufous, thorax flavous, head with distinct longish tubercle below the dark fuscous, almost black antennæ; wings with two horny maculæ; stigma yellow or fulvous.

Length, 30 mm.

Head yellowish, antennæ dark fuscous, almost black, with a distinct longish tubercle below the base; thorax flavous, pleuræ and scutellum yellowish, mesonotum marked with dark fulvous, not fuscous; metathorax smooth and impunctate, with a rather indistinct anterior transverse carina, behind which it is faintly wrinkled.

Wings with stigma yellow or fulvous; discocubital cell with two maculæ; apex of abdomen fuscous.

I have not seen a specimen of this species, and can only give Cameron's description slightly modified.

Type.—♀. British Museum.

Cameron remarks that this species considerably resembles *E. flavo scutellatus* in color, but differs in being smaller, with a distinct longish tubercle below the antennæ and no dark fulvous markings on the mesonotum. Comparison of the descriptions shows that it is very closely related to *E. sphacelatus* Erich., and it is perhaps a synonym of that species.

Distribution.—San Gerónimo, Guatemala.

Enicospilus nigricornis Br.

Ophion nigricornis Brullé, Hist. Nat. Ins., Hym., IV, p. 141, n. 8, Brazil .....1846.
" " Dalla Torre, Cat. Hym., III, p. 196.....1901.
Henicospilus nigricornis Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 64.....1905.

Rufous, apex of abdomen fuscous; vertex and antennæ black; head, sides of thorax and scutellum flavous; discocubital cell with one linear arcuate macula.

Length, 25 mm.

Head yellow, vertex in ocellar region black; antennæ black, with the first joint red beneath and the second red at the extremity; thorax with pleuræ and scutellum flavous; mesonotum marked with three indistinct brown lines; first region of the metathorax smooth, the posterior edge raised, with two small median lobes; second region with sides irregulary rugose and angled, the convexity being directed backward.

Wings with glabrous area of discocubital cell containing an arched red line; the nervures are brown and the stigma red.

Abdomen with first two basal segments red, the third red at the base and dorsally—the rest yellow—the fourth yellow, with the posterior half brown, the rest of the abdomen brown.

Type.—Location unknown to me.

I have not seen a specimen of this species, and can only give a free translation of Brullé's description. There is some question as to the right location and even validity of the species; the linear macula may be an abnormality, and the species belong in reality to the Genus *Eremotylus*, or a second macula may have been lacking in the type and the species, while belonging to the Genus *Enicospilus*, may prove to have been already described.

Distribution.—Brazil.

Enicospilus cressoni n. sp.*

? *Ophion* (*Enicospilus*) *mexicanus* Cameron, Biol. Centr. Amer., Hym., 1, p. 290, n. 1, pl. 12, fig. 23, Cordoba, Mexico; San Gerónimo, Guatemala.....1886.

Flavo-fuscous, vertex and antennæ black, metanotum dark fuscous, abdomen flavo fuscous; discocubital cell with one usually appendiculate macula.

Length, 20–25 mm.; wing, 14–16 mm.; spread, 30–34 mm.; antennæ, 20–26 mm.

Head flavous, vertex and antennæ black; ocelli large, prominent, well separated; eyes large, emarginate; clypeal foveæ distinct; thorax flavous; mesonotum dark fuscous or black—in some specimens this may be divided into three longitudinal stripes—sternum and thoracic sutures fuscous; scutellum flavous; metathorax with a distinct anterior transverse carina, in front of which it is smooth, behind finely reticulate, with more or less distinct arcuate carinæ.

Wings hyaline, iridescent, slightly tinged with fulvous; stigma fulvous, nervures slightly fuscous; discocubital cell longer than usual, with one triangular macula having a short arcuate appendix; basal half of radial vein slightly thickened, with a short distinct arc in the center; nervulus antefurcal, to interstitial, nervellus broken far below the middle; first recurrent vein about one-third the length of the second. Legs flavous, claws pectinate. Abdomen flavo-fuscous.

Described from three ♀ cotypes from Mexico and Santo Domingo.

Cotypes.—Two ♀'s, Mexico; one ♀, Santo Domingo; American Entomological Society.

This species apparently resembles the specimens which Cameron considered *E. mexicanus* Cresson; the color, long

* Named in honor of Mr. E. T. Cresson.

discocubital cell, etc., are alike in both, but Cameron's plate shows that his specimens had two maculæ. This is apparently only a variation and they probably belong with this species, but certainly are not *E. mexicanus* Cress.

Nothing is known of the life history, habits, or hosts of this species.

Enicospilus fernaldi n. sp.*

Flavo-fulvous, sericeous, vertex black, mesonotum with three more or less distinct fuscous stripes, abdomen beyond the fourth segment dark fuscous or black, stigma fulvous, discocubital cell with two maculæ, the larger with a more or less distinct appendix.

Length, 12–18 mm.; wing, 10–12 mm.; spread, 21–26 mm.; antennæ, 12–18 mm.

Head flavous, vertex and antennæ fuscous; eyes large, emarginate; clypeal foveæ distinct.

Thorax of general color, fulvous, more or less tinged with flavous, and in one specimen almost entirely of a greenish yellow; pectus, and rarely the scutellum, flavous; mesonotum with three more or less distinct fuscous stripes; scutellum usually flavous; metathorax with weak anterior transverse carina, in front of which it is smooth, behind densely and finely rugose; wings hyaline, iridescent, stigma flavous, discocubital cell with two maculæ, the larger with a more or less distinct short appendix, the smaller erect crecentic, at the other end of the glabrous area; nervulus antefurcal to interstitial, nervellus broken well below the middle; first recurrent vein one-half the length of the third.

Abdomen with the four basal segments fulvous, beyond the fourth segment black; the two basal segments linear, of about equal length.

Described from two ♀ and one ♂ specimens.

Cotypes.—Two ♀'s and one ♂ in U. S. National Museum from San Francisco Mountains, Santo Domingo.

This species resembles *E. flavus* in color but is smaller. The antennæ and apex of the abdomen are black, not fuscous as in *flavus;* the maculæ also differ in shape. It does not seem to be *E. bicolor*, for in that species the wings are flavo-hyaline, and the amount of flavous on the abdomen differs.

Distribution.—San Francisco Mountains, Santo Domingo, September, 1905.

Nothing is known of the life history and habits.

* Named in honor of Prof. C. H. Fernald.

Enicospilus monticola Cam.

Ophion (*Enicospilus*) *monticola* Cameron, Biol. Centr. Amer., Hym., I, p. 292, n. 7, pl. 12, fig. 28.....1886.
Henicospilus monticola Dalla Torre, Cat. Hym., III, p. 182.....1901.
" " Szepligeti, Gen. Ins., 34me Fasc., p. 27, n. 62. ♀ .....1905.

Luteous to fulvous; antennæ, vertex and third to eighth segments of the abdomen black, wings hyaline, stigma black, discocubital cell with two maculæ.

Length, 22–25 mm.; wing, 18 mm.; spread, 38 mm.; antennæ, 25 mm.

Luteous to fulvous, eyes and face flavous, vertex black; ocelli large, prominent, well separated; antennæ black, slender, about as long as the body; thorax of the general color; mesonotum more or less tinged with black, scutellum long and narrow, with distinct lateral keels; metathorax with strong anterior transverse carina in front of which it is smooth, behind coarsely reticulated, with median keels straight at the base, then diverging towards the sides.* Wings hyaline, iridescent; stigma and nervures black; basal half of radial vein slightly thickened; discocubital cell with two maculæ, the larger subtriangular, the smaller varying from circular to almost crescentic; discocubital vein with the outer two-thirds nearly parallel to the discoidal vein; first recurrent vein one-half the length of the second; nervulus antefurcal to interstitial; nervellus broken far below the middle; legs of the general color, claws pectinate.

Abdomen with the two basal segments subequal, the first becoming gradually thickened toward the apex; segments 3 to 8 black.

In redescribing this species I have compared one specimen with the original description.

Cotypes.—Two ♀'s, British Museum.

Distribution.—This species is apparently tropical or subtropical; the two cotypes were taken at Las Mercedes, Guatemala, at 3,000 feet, and San Indro at 1,600 feet, and I have specimens before me from Mexico and from Santo Domingo, West Indies.

Nothing is recorded of the life history, habits or hosts.

* Cameron says "with a transverse keel towards the basal half, behind which it is smooth; in front of it coarsely reticulated and bearing in the center keels which are straight at the base and then diverge toward the sides," but in the specimen before me it is as I have described.

Location of specimens.—British Museum, two ♀ cotypes. U. S. National Museum, from Santo Domingo and Mexico. American Entomological Society (Philadelphia), ♀, Mexico.

Enicospilus nigricauda Tasch.

Ophion nigricauda Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 437, n. 27, ♀.....1875.
" " Dalla Torre, Cat. Hym., III, p. 196.....1901.
Henicospilus nigricauda Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 63.....1905.

Testaceous, vertex flavous, apex of abdomen black, wings hyaline, veins fuscous, discocubital cell with one macula.

Length, 18–20 mm.

Sericeous to testaceous, vertex and occiput sulphur-yellow; ocelli large, filling the space between the tops of the eyes completely.

Scutellum and spots on the pleuræ sulphur-yellow; metanotum with an anterior transverse carina and lateral longitudinal ridges; with fine irregular transverse ridges behind the shell-yellow ground color of the scutellum and mesopleuræ, often somewhat lighter. Wings hyaline, with one macula in the discocubital cell; nervures shining fuscous.

Abdomen black from the fifth or tip of the fourth segment to the apex.

I have not seen specimens of this species, and can only give a free translation of Taschenberg's description.

Cotypes.—Three ♀'s, location unknown to me.

This species resembles *E. flavus*, but the latter has the vertex black and the apex of the abdomen at the most only fuscous.

Distribution.—Brazil; Venezuela.

Enicospilus thoracicus (Cress.).

Plate III, fig. 22.

Ophion thoracicus Cresson, Proc. Ent. Soc. Phila., IV, p. 55, ♀, Cuba.....1865.
" " " Proc. Acad. Nat. Sci. Phila., p. 374, n. 2, Cordova.....1873.
" *trimaculatus* Taschenberg, Zeitschr. f. d Ges. Natur., 46, p. 433, n. 18, ♀.....1875.
" (*Enicospilus*) *thoracicus* Cameron, Biol. Centr. Amer., Hym., I, p. 291, n. 3, Mexico, Cuba.....1886.
" *thoracicus* Fox, Trans. Amer. Ent. Soc., 18, p. 337, Jamaica.....1891.

Enicospilus thoracicus Ashmead, Trans. Ent. Soc. Lond., p. 271, n. 182, p. 354, n. 1092.....1900.
Henicospilus thoracicus Dalla Torre, Cat. Hym., III, p. 184.....1901.
Ophion trimaculatus Dalla Torre, Idem, p. 199.....1901.
Henicospilus thoracicus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 66.....1905.
" *trimaculatus* Szepligeti, Idem, p. 27, n. 68.....1905.
" *trispilus* Szepligeti, Ann. Hist. Nat. Musei Nationalis Hung., IV, p. 145.....1906.

Fulvous, antennæ flavo-fuscous, vertex flavous, mesonotum with three longitudinal stripes more or less distinct; discocubital cell with one large macula and two lines; vertex flavous.

Length, 21–28 mm.; wing, 16–18 mm.; spread, 34–38 mm.; antennæ, 21–30 mm.

Fulvous, sometimes varied with fuscous; head flavous—in one specimen rufous—ocelli large, prominent, well separated, the two posterior close to the tops of the eyes; eyes large, emarginate; antennæ fulvous, more or less tinged with fuscous, as long as the body; clypeal foveæ distinct.

Thorax flavo-fuscous, clothed with fine short pubescence; pectus flavous; mesonotum with three broad black longitudinal stripes, sometimes indistinct behind; scutellum flavous; metathorax tinged with fuscous or black, slightly hollowed behind, with a distinct anterior transverse carina, in front of which it is smooth, behind with longitudinal and sometimes transverse carinæ, frequently a weak median longitudinal carina is present.

Wings hyaline, faintly iridescent; stigma and most of the costa flavous, nervures otherwise fuscous; discocubital cell with one large subtriangular macula and two lines, the anterior short and straight, the posterior long and curved; usually distinctly separated from the macula, but in one specimen faintly connected; nervulus antefurcal to interstitial; nervellus broken far below the middle; radius with basal half thickened; discocubital vein bent; legs fulvo-ferruginous, sometimes slightly lighter colored than the rest of the body.

Abdomen strongly compressed and shining, the two basal segments linear, of about equal length, slightly dilated toward the tips. The entire abdomen, especially the two basal segments, more or less fuscous.

In redescribing this species I have examined the cotypes and four ♀ and one ♂ specimens.

Cotypes—Two ♀'s, Mexico, Cuba; in collection of American Entomological Society (Phila.).

A distinct species easily recognized by its size, three black

stripes on the mesonotum, and shape of the three maculæ. In one male specimen from Mexico the entire abdomen is dark fuscous, but this is perhaps due to greasing. Cameron seems to intimate that what I call *thoracicus* is really *flavoscutellatus* Br., but this is impossible, for Brullé's species has only one macula in the wing while *thoracicus* has three, or at least (sometimes) two. *E. trispilus* Szep. is apparently a synonym of this species, and *Ophion trimaculatus* Tasch.* certainly is.

Distribution.—This species is apparently tropical but with a wide range which may extend beyond the tropics. It has been reported from Cordova, San Rafael (Jicoltepec) Mexico; Cuba; Bog Walk, Parish of St. Catherine, Jamaica; Merida, Venezuela; Mapiri, Bolivia; Nova Friburgo, Brazil; and I have seen specimens from Mexico; Cuba; Balaclava, Jamaica; San Francisco Mountains, Santo Domingo, and Chauchamayo, Peru.

Life history.—Nothing is recorded concerning the life history of this species and no hosts have been reported. One specimen from Santo Domingo was taken in September. The single cocoon which I have seen is dark brown with two irregular, longitudinal black stripes: 20 mm. long and 8.5 mm. broad.

Location of specimens.—American Entomological Society, two ♀ cotypes, No. 77. U. S. National Museum, homotypes and specimens from San Rafael, Mexico; Cuba; Jamaica; San Francisco Mountains, Santo Domingo; Grenada. Massachusetts Agricultural College, homotype, ♂, Mexico. Hungarian National Museum. Three ♂ cotypes of *E. trispilus* from Mexico, Venezuela, and Bolivia.

* The name *Ophion trimaculatus* Taschenberg, 1875, was a homonym, having already been used by Olivier, Encycl. Meth., Ins., VIII, p. 59, 1811, sixty-four years before. Szepligeti transfers the species to the Genus *Enicospilus*, but with no change of name and even if the species were good the name is not valid. According to rulings of the Committee of Nomenclature, "A stillborn homonym can not be used again even when a species is transferred to another genus."

Enicospilus flavo-scutellatus (Br.)

Ophion flavo-scutellatus Brullé, Hist. Nat. Ins., Hym., IV, p. 140, n. 6, Brazil.....1846.
" (*Enicospilus*) *flavo-scutellatus* Cameron, Biol. Centr. Amer., Hym., I, p. 291, n. 4, pl. 12, fig. 25, Guatemala, Costa Rica.1886.
Henicospilus flavo-scutellatus Dalla Torre, Cat. Hym., III, p. 181..1901.
" " " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 56.....1905.

Luteous; head, sides of thorax and scutellum flavous; mesonotum with three fuscous lines, metathorax weakly rugose, wings with one red macula.

Length, 25–30 mm.

Pale yellow, a little reddish, head, pleuræ and scutellum sulphur-yellow, antennæ slightly ferruginous; mesonotum luteous, with three broad black or brown lines of which the median is incomplete; metathorax with distinct median keel, the first region smooth, with a carina reentrant in the middle like a very open band; second region finely rugose, with more or less distinct broad transverse fuscous band; wings with stigma red, nervures brown, the glabrous area of the discocubital cell with one red macula; apical segments of the abdomen brown.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Type.—Location unknown to me.

I am not sure of the identity of this species; Cameron's specimens were evidently *thoracicus* in which the small third macula was lacking, for his plate shows this condition, which is often found in that species. They can not be *flavo-scutellatus*, which, according to the original description, has only one macula. Cameron lists *thoracicus* from Mexico and Cuba, but does not state how he separates the two species.

Distribution.—Rio Grande, Brazil; Cerro Zunil, Guatemala; Irazu, Costa Rica

This species is apparently tropical, but its exact range is still unknown.

Location of specimens.—British Museum.

Enicospilus guatemalensis (Cam.)

Ophion (*Enicospilus*) *guatemalensis* Cameron, Biol. Centr. Amer., Hym., I, p. 293, n. 9., ♀, pl. 12, fig. 22 .....1886.

Henicospilus guatemalensis Dalla Torre, Cat. Hym., III, p. 182, listed, Guatemala.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 59, listed 1.....1905.

Pale flavous, vertex yellow, wings hyaline, stigma pale flavous, discocubital cell with one subtriangular horny macula.

Length, 18 mm.

Body flavous, unicolorous, vertex flavous. Thorax with scutellum more gibbous than in *E. concolor*, not narrowed behind, scarcely keeled at the sides and not punctate but finely striate at the apex; metanotum without median keel; wings hyaline, the third discoidal cellule not so dilated at the apical half as in *concolor*, discocubital cell with one pear-shaped macula, nervulus interstitial.

In its unicolorous body this species agrees with *E. concolor* but is much smaller, and the color more dilute in tint; *E. flavus* may be separated from this species by the deeper fulvous tint of the body, by the middle of the vertex being black, and the mesonotum punctate.

I have not seen a specimen of this species, and can only give Cameron's description rearranged. It is apparently closely related to *E. purgatus*.

Type.—British Museum.

Distribution.—Guatemala (San Gerónimo).

Enicospilus neotropicus n. sp.

Flavo-fuscous; vertex yellow, pectus and abdomen fuscous; antennæ fulvous to fuscous; stigma fulvous, wings with one macula.

Length, 16–20 mm.; wing, 11–14 mm.; spread, 24–30 mm.; antennæ, 15–20 mm.

Body clothed with fine, short pubescence.

Head flavous; ocelli large, prominent, well separated, the posterior close to the tops of the eyes; eyes large, emarginate; antennæ as long as the body, flavo-fuscous with a weak, sometimes indistinct, carina between the antennal fossæ; clypeal foveæ distinct, mandibles bidentate, tipped with black.

Thorax flavo-fuscous, pectus fuscous, mesonotum varying from light to dark fuscous, with three more or less distinct longitudinal black lines; pleuræ flavous, tinged with black; metathorax rounded behind, with a weak anterior transverse carina, in front of which it is smooth, behind finely reticulated; wings hyaline, iridescent, stigma fulvous, nervures fuscous; nervulus postfurcal to interstitial, nervellus broken far below the middle, basal half of radial vein slightly enlarged, discocubital vein bent, discocubital cell with one subtriangular macula; first recurrent nervure three-fourths the length of the second; legs light flavous to fuscous; abdomen fuscous, more or less tinged with black.

Described from two female and two male cotypes.

Cotypes.—♀ and ♂, U. S. National Museum; ♀ and ♂, Massachusetts Agricultural College.

This species is related to *E. guatemalensis* in structure, venation and shape of the macula, but shows a constant wide difference in color. Cameron described *guatemalensis* from a single female specimen which may prove to be an albino, but as the description is so incomplete and the type unavailable, the question can not be settled without a large number of specimens. *E. neotropicus* seems, however, to be a good species.

Distribution.—This species is apparently tropical, for it has been taken in the San Francisco Mountains, Santo Domingo, and in Chili.

Nothing is known of the life history or habits, but two of the cotypes were taken in Santo Domingo during September.

Location of specimens.—U. S. National Museum, cotypes from Santo Domingo. Massachusetts Agricultural College, cotypes.

Enicospilus brullêi n. n.*

Ophion striatus Brullé, Hist. Nat. Ins., Hym., IV, p. 142, n. 11...1846.
" " Dalla Torre, Cat. Hym., III, p. 199,.....1901.
Henicospilus striatus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 65.....1905.

Rufous, vertex black, pleuræ and scutellum flavous; wings with one macula.

Length, 20 mm

Red, head yellow, vertex and longitudinal shaft of the face black, thorax with sides yellow; mesonotum marked with three broad, light brown lines; edges of mesothorax of the same color, scutellum flavous; metathorax with the posterior edge of its first region nearly straight, the second region with distinct transverse wrinkles; wings with the nervures brown, stigma yellowish red; discocubital cell with one macula at the end of the glabrous area; abdomen "lost beyond the third segment."

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* This species was originally described by Brullé as *Ophion striatus*, but it evidently belongs in the genus *Enicospilus*. It was first transferred to that genus by Szepligeti in 1905, but with no change of name; the specific name was, however, preoccupied by *E. striatus* Cameron, 1899, and according to the International Code, Art. 34, *E. striatus* must be rejected as a homonym. I therefore rename this species *Enicospilus brullêi*.

I have not seen a specimen of this species, and can only give a free translation of Brullé's description.

Type.—Location unknown.

Distribution.—Rio de Janeiro, Brazil.

Enicospilus trilineatus (Br.).

Ophion trilineatus Brullé, Hist. Nat. Ins., Hym., IV, p. 140, n. 7, Brazil.....1846.
" Dalla Torre, Cat. Hym., III, p. 199.....1901.
Henicospilus trilineatus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 67.....1905.

Luteous; head, thorax and scutellum flavous; vertex black, mesonotum with fuscous lines, metathorax slightly striated, stigma flavous, discocubital cell with one macula; antennæ with basal two-thirds black.

Length, 22 mm.

Head yellow, vertex black in ocellar region; basal two-thirds of antennæ black.

Thorax with sides partly yellow and partly red; mesonotum yellow, with three brown lines sometimes indistinct; metathorax slightly striated with the first region more prominent at the posterior edge than in *flavo-scutellatus*, and nearly straight; second region without longitudinal keels, its wrinkles forming quite regular arched lines; scutellum flavous.

Wings with stigma yellow, the glabrous area of the discocubital cell with one small red macula (speck).

Abdomen with three basal segments red, sides of the third and fourth yellow, the latter with a ventral triangular brown spot more or less drawn out, the rest entirely brown.

I have not seen a specimen of this species and can only give a free translation of the original description.

Type.—Location unknown to me.

This species resembles *E. flavoscutellatus*, but differs in that the pleuræ are partly yellow and partly red, and the vertex in the region of the ocelli black.

Distribution.—Rio de Janeiro, Brazil.

Enicospilus flavus (Fabr.).

Plate III, fig. 24.

Ichneumon flavus Fabricius, Syst. Ent., p. 341, n. 76.....1775.
" " " Spec. Ins., I, p. 436, n. 96.....1781.
" " " Mant. Ins., I, p. 268, n. 114.....1787.
" " Gmelin, Linné; Syst. Nat., ed. 13a I, 5, p. 2707, n. 178.....1790.

Ichneumon flavus Christ, Naturg. d. Ins., p. 360.....1791.
" " Olivier, Ency. Method., Ins., VII, p. 196, n. 157.....1792.
" " Fabricius, Ent. Syst., II, p. 179, n. 188.....1793.
Ophion flavus Fabricius, Suppl. Ent. Syst., p. 236, n. 3.....1798.
" " " Syst. Piez., p. 131, n. 4.....1804.
" " Olivier, Ency. Method. Ins., VIII, p. 509, n. 5.....1811.
Ichneumon flavarius Thunberg, Mem. Acad. Sci., St. Petersbourg, VIII, p. 262.....1822.
" " Thunberg, Mem. Acad. Sci., St. Petersbourg, IX, p. 314.....1824.
Ophion flavus Guérin and Percheron, Gen. Dis. Ins., liv. 2, H. 7, T. 3.....1835.
" " Brullé, Hist. Nat. Ins., Hym., IV, p. 139, n. 3, ♀ Cayenne.....1846.
" " Guérin, Ramon de la Sagra, Hist. Fis. Cuba, VII, p. 753.....1857.
" " Cresson, Proc. Ent. Soc. Phila., IV, p. 57, Cuba...1865.
" (*Enicospilus*) *flavus* Cameron, Biol. Centr. Amer., Hym., p. 292, n. 6, tab. 12, f. 21, Cordova, Mexico; Chontales, Nicaragua; Antilles, Cuba.....1886.
" *flavus* Fox, Trans. Amer. Ent. Soc., XVIII, p. 338, numerous specimens from Port Antonio, Jamaica...1891.
" *flavum* Ashmead, Journ. Linnean Soc. Zool., XXV, p. 58, St. Vincent Island.....1894.
Enicospilus flavus Ashmead, Trans. Ent. Soc. Lond., p. 270, n. 181, 354.....1900.
Henicospilus flavus Dalla Torre, Cat. Hym., III, p. 181, Centr. America.....1901.
Ophion (*Enicospilus*) *appendiculatus* Felt, Psyche, IX, p. 308, n. I..1902.
Enicospilus appendiculatus Felt, N. Y. State Mus., Bull. 76 (nineteenth Rept. State Ent.), p. 113, pl. 2, fig. 4, New Brunswick, N. J.; Selma, Ala.....1904.
Henicospilus flavus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 57, listed Am. Centr.....1905.
" *appediculatus* Szepligeti, Idem, n. 69, listed Am. Bor.....1905.
Enicospilus flavus Cameron, Journ. Roy. Agr. and Commer. Soc. British Guiana, I, p. 179.....1911.

Flavous to ferruginous, vertex black, apex of abdomen usually fuscous, discocubital cell with one large and one small indistinct macula (pl. 2, fig. 24). *Scutellum flavous; antennæ fulvous to fuscous.*

Length, 12–23 mm.; wing, 11-14 mm.; spread, 23–28 mm.; antennæ, 16–17 mm.

Flavous, more or less tinged with red, and coated with fine short pubescence. Face and occiput flavous, vertex black; ocelli large, prominent, well separated, black with outer ring of yellow. Antennæ fulvous to fuscous, as long as the body; eyes large, emarginate; clypeal foveæ distinct, mandibles bidentate, tipped with black—in one specimen the face is dark red—mesonotum flavo-fuscous, frequently with three longitudinal fuscous stripes; mesopleuræ smooth and polished, yellow, varied with red; scutellum sulphur-yellow. Metathorax with a weak anterior transverse carina, in front of which it is smooth, behind finely reticulate; wings hyaline, stigma yellow, nervures slightly fuscous; discocubital cell usually with two maculæ, one large and subtriangular, with a short appendix, the other small, irregular, frequently indistinct, sometimes lacking; radial vein lightly narrowed near the stigma, thickened beyond, discocubital vein arcuate or in some cases angled, not sinuate, nervulus interstitial to well postfurcal; nervellus broken far below the middle.

Legs usually slightly lighter than the body, claws pectinate; abdomen with the two basal segments linear; usually fuscous beyond the fourth segment. Ovipositor short, 2 mm., male claspers rounded.

In describing this species I have examined thirteen ♀ and eight ♂ specimens.

Type.—Location unknown.

Fabricius' description is so incomplete that determination has hitherto been doubtful. In determining and redescribing this species I have used specimens determined by Mr. E. T. Cresson and Cameron's figure of a wing—which agree—as well as the various descriptions. Cresson notes that *E. flavus* is slightly smaller than *cubensis*, with the abdomen shorter and not so slender, the membranaceous spots nearest the tips of the discocubital cell very small and indistinct. A large series, however, shows that none of these differences are fixed. It is closely related to *E. cubensis* and *E. concolor*, but is readily recognized by the differently shaped maculæ, which appear quite fixed. The type of *E. appendiculatus* Felt shows what the figure and description of the wing* intimate, namely, that it is a synonym of *E. flavus*. Dr. Felt remarks that *appendiculatus* is evidently southern in habitat but fails to recognize it as *flavus*, which is seldom taken far north—probably because that species is so little known and its description is so incomplete.

* N. Y. State Museum, Bull. No. 76, p. 113, pl. 2, fig. 4, 1903.

Distribution.—This species is most abundant in and near the tropics, but ranges from the Upper Austral at New Brunswick, N. J., into the tropics at Chontales, Nicaragua, and the Island of St. Vincent. It has been reported from Mexico; Chontales, Nicaragua; Cuba; San Antonio, Kingston, etc., Jamaica; Mirabeau Estate, St. Vincent Island; Grenada Island; Cayenne; and I have seen specimens from New Brunswick, N. J.; Selma, Ala.; Dallas, Texas; Mexico; Cuba; Portland, Raetown and Kingston, Jamaica; San Francisco Mountains, Santo Domingo.

Life history and habits.—Little is known or at least recorded of the life history, habits or hosts of this species. Three female specimens before me were taken at Selma, Ala., in October; Paris, Texas, September 8; and Dallas, Texas, September 30, respectively. Two females from Santo Domingo were taken in September, and a third from Kingston, Jamaica, in March. *E. flavus* seems therefore to be most abundant in August and September, but the time of flight may extend over several months as with other species.

Location of specimens.—American Entomological Society (Phila.), six ♀'s and seven ♂'s; Cuba; Mexico; Jamaica; Santo Domingo. U. S. National Museum, two ♀'s and two ♂'s, Santo Domingo; Selma, Ala. (two metatypes, *E. appendiculatus* Felt); Portland, Raetown, Kingston, Jamaica; Cuba; San Francisco Mountains, Santo Domingo; Grenada; Windward Islands; St. Vincent; Aguadilla, Porto Rico. New York State Museum (Albany), ♀ from New Brunswick, N. J. (type of *E. appendiculatus* Felt). British Museum.

Enicospilus concolor (Cress.).

Plate II, fig. 12.

Ophion concolor Cresson, Proc. Ent. Soc. Phila., IV, p. 56, ♀ ♂, Cuba.....1865.

" (*Enicospilus*) *concolor* Cameron, Biol. Centr. Amer., Hym., I, p. 291, pl. 12, fig. 24..1885.

" *concolor* Fox, Trans. Amer. Ent. Soc., XVIII, p. 337, Jamaica.....1891.

" " Ashmead, Journ. Linn. Soc. Zool., XXV, p. 58, listed, Island of St. Vincent....,.....1894.

Enicospilus concolor Ashmead, Trans. Ent. Soc. Lond., p. 271, n. 182, Grenada.....1900.

Henicospilus concolor Dalla Torre, Cat. Hym., III, p. 181, Cuba...1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 54.....1905.

Pale fulvous; head, pleuræ and scutellum more or less tinged with flavous; vertex fuscous or black; wings hyaline, iridescent, with two maculæ, the larger lanceolate, the smaller linear-oblong, slightly indistinct.

Length, 14–20 mm.; wing, 12–14 mm.; spread, 26–29 mm.; antennæ, 20–24 mm.

Pale fulvous, clothed with fine, short pubescence; head often flavous; antennæ uniformly fulvous, frequently light, as long or longer than the body; ocelli large, prominent, well separated, the posterior close to the tops of the eyes; eyes large, emarginate; clypeal foveæ deep; mandibles bidentate, tipped with black.

Thorax fulvous, pleuræ tinged with flavous; mesonotum slightly fuscous, scutellum more or less yellow; metathorax with an anterior, transverse carina, in front of which it is smooth, behind finely areolated.

Wings hyaline, iridescent, stigma pale fulvous, nervures fulvous to fuscous*; nervulus antefurcal to interstitial, nervellus broken far below the middle, basal half of the radial vein slightly enlarged, discocubital vein bent; discocubital cell with two maculæ, the larger lanceolate, with a more or less distinct appendix, the smaller linear-oblong, often indistinct.

Legs uniformly pale fulvous, claws pectinate.

Abdomen shining fulvous; the two basal segments linear, about equal in length and slightly dilated towards the apex; the second segment stouter than the first; the others compressed and gradually enlarged; the two apical segments sametimes fuscous.

In redescribing this species I have compared the cotypes with five female and one male specimens.

Cotypes.—Two ♀'s and one ♂, No. 76, Cuba, American Entomological Society.

This species is closely related to *E. flavus*, but may be readily recognized by the differently shaped maculæ and usually smaller size. In the specimens which I have seen these characters seem well fixed. Cameron's specimens represent an altogether different species, as the figure shows, but as I have not seen the types or similar specimens I can only treat them among the unknown.

* Specimens which Cameron considered *E. mexicanus* answer this description aside from their having a second macula; this may be a simple variation.

Distribution.—This species is tropical, ranging through most of the West Indies. It has been reported from Cuba, Jamaica, St. Vincent and Grenada, and I have seen specimens from Santiago de Cuba; Portland, Jamaica; and Bridgetown, Barbados.

Nothing is recorded of the life history or habits of this species; the specimen from Barbados was taken on December 1.

Location of specimens.—American Entomological Society: cotypes, two ♀'s and one ♂, No. 76, Cuba; paratypes, two ♀'s and one ♂, Cuba, ♀, Portland, Jamaica. American Museum Natural History, ♀, Santiago de Cuba. Massachusetts Agricultural College, paratype, ♀, Bridgetown, Barbados, December 1, 1902. British Museum.

Enicospilus purgatus arcuatus (Felt.)

Plate III, fig. 23.

Ophion (*Enicospilus*) *arcuatum* Felt, Psyche, Vol. IX, p. 307, February.....1902.

Eniscopilus arcuatus Felt, N. Y. State Mus., Bull. 76, pp. 108, 112, pl. 1.....1904.

Henicospilus arenatus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 70.....1905.

Light fulvo-ferruginous, varied with fuscous; vertex flavous; wings hyaline, iridescent, with two maculæ, the larger with a long appendix, extending around the outer end of the glabrous area; bulla of discocubital vein distant one-half the width of the third discoidal cell from its apex.

Length, 20–30 mm.; wing, 14–20 mm.; spread, 30–42 mm.; antennæ, 21–33 mm.

Head flavous—in one specimen entirely rufous—vertex flavous; ocelli large, equidistant, prominent, well separated, the posterior close to the tops of the eyes; antennæ slightly longer than the body; eyes emarginate; clypeal foveæ deep; mandibles bidentate, tipped with black.

Thorax sericeous, flavous, more or less tinged with fuscous; mesonotum and metathorax frequently fuscous or ferruginous; pleuræ frequently tinged with fuscous; scutellum prominent, flavous, with lateral keels; metathorax with anterior transverse carina frequently weak or entirely wanting, the anterior fourth smooth, the posterior three-fourths finely areolate, frequently with distinct arcuate keels originating at the insertion of the abdomen; weak median longitudinal furrows are frequently present, with more or less distinct lateral carinæ.

Wings hyaline, occasionally tinged with fulvous, stigma and costa flavous, nervures tinged with fuscous; marginal nervure (costa) slightly thickened and sinuate near the small stigma, discocubital vein weakly sinuate, its bulla one-half the width of the third discoidal cell from its apex; discocubital cell with two maculæ in the glabrous area, the larger subtriangular, with a chitinous, usually yellowish, continuation along the hinder margin of the glabrous area to a point beyond the smaller macula, which is anterior and lateral to the center of this area; the smaller subtriangular to crescentic; nervulus antefurcal to interstitial, nervellus broken far below the middle, first recurrent vein about one-half the length of the second. Legs flavous, claws pectinate.

Abdomen flavo-fuscous, strongly compressed and varied with fuscous or black along the venter and at the apex, the two basal segments slender; claspers of male rounded apically.

In redescribing this species I have examined two ♀ cotypes, twelve ♀ and one ♂ specimens.

Cotypes.—Three ♀'s, New York State Museum, Albany; ♀, Cornell University, Ithaca; ♀, Massachusetts Agricultural College. Paratype, U. S. National Museum.

This is a comparatively rare subspecies often confused with *E. purgatus* Say, since it is probably found throughout the range of the latter; it is, however, usually larger and lighter colored than *E. purgatus*, while the larger macula is appendiculate and the bulla of the discocubital vein distant one-half the width of the third discoidal cell from its apex; in *purgatus* the larger macula is usually not appendiculate and the bulla of the discocubital vein is distant only one-fourth of the width of the third discoidal cell from its apex. However, these differences are not constant, but appear in different degrees and combinations in both, and I do not see how *arcuatus* can be considered more than a subspecies. The fact that the distributions of the two coincide favors this view.

Distribution.—The range of this species probably coincides with that of *E. purgatus* Say, although data available at present show a somewhat more limited distribution. The present known range extends from Durham, N. H., to Illinois, and south to Florida and Mexico. It has been reported from Illinois and Georgia, and I have seen specimens from New Hampshire, Massachusetts, Connecticut, Rhode Island, New

York, New Jersey, Colorado, Illinois, Pennsylvania, Florida, and Mexico.

Nothing is recorded of the life history, habits or hosts, but they are probably similar to those of *E. purgatus*. One specimen in the collection of the U. S. National Museum was bred from *Scoliopteryx libatrix*.

Location of specimens.—Specimens will be found in the following collections: American Entomological Society; U. S. National Museum, from Waltham and Provincetown, Mass., (September 5) and Long Island, N. Y.; Pennsylvania State College; Boston Society Natural History; Massachusetts Agricultural College, cotype, etc.; New York State Museum (Albany), cotype; Cornell University, cotype.

Enicospilus maculipennis (Cam.).

Ophion (*Eniscopilus*) *maculipennis* Cameron, Biol. Centr. Amer., Hym., I, p. 292, n. 8, pl. 12, fig. 29, ♀.....1886.
Heniscopilus maculipennis Dalla Torre, Cat. Hym., III, p. 182....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 60.....1905.

Flavous; sternum, stigma and three spots on the mesonotum, black; wings hyaline, with substigmal fuscous band along the base of the radius.

Length, 18 mm.

Head impunctate, shining; antennæ yellow, fuscous toward the apex, longer than the body.

Mesonotum finely and closely punctured with three black spots; scutellum more strongly punctured and with strong lateral keels; mesopleuræ closely punctured, partly black; metanotum with a transverse carina, in front of which there are coarse transverse striations, behind it is finely punctured; pro,- meso- and metasterna black; the black extends from the mesosternum half-way up the mesopleuræ, and is continued in the middle to the base of the posterior wings as an oblique band. *Wings* hyaline, stigma black except at base and apex, where it is yellow; costa yellow, the other nervures black; the larger macula distinct, about one-half longer than broad and obliquely truncated at the apex.

Legs clear, pale yellow; middle coxæ with a black mark on the under side, and the posterior coxæ with a larger mark.

Abdomen with apical half of petiole more or less black, the three following segments inclining to fuscous above.

I have not seen a specimen of this species, and can only

give Cameron's description somewhat rearranged. It is evidently a distinct, well marked species.

Type.— ♀. British Museum.

Distribution.—Bugaba, Panama.

Enicospilus sphacelatus (Erichs.).

Ophion sphacelatus Erichson, Schömburg's Reise in Brit. Guiana, Part III, p. 587, British Guiana.....1848.
" (*Eniscopilus*) *fuscicornis* Cameron, Biol. Centr. Amer., Hym., I, p. 291, n. 5, San Geronimo, Guatemala .,.....1886.
" *sphacelatus* Dalla Torre, Cat. Hym., III, p, 199.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 110.....1906.

Dark reddish-yellow; apex of abdomen darker, often brown; head flavous, with a small reddish-yellow tubercle below the base of the antennæ; wings hyaline, discocubital cell with two maculæ.

Length, 17 mm.

Dark reddish-yellow; head bright yellow, with a small, rather long, reddish-yellow tubercle below the base of the antennæ; antennæ reddish yellow; wings hyaline, the basal nervures brown, those of the apex reddish-yellow; discocubital cell with two maculæ; abdomen strongly compressed, towards the apex darker, often brown.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Type.—Location unknown.

This species has hitherto been placed among the Ophions, but a glance at the description shows at once that it belongs to the genus *Enicospilus*. The identity of this species is in doubt, as the "small tubercle" may not be constant and the other characteristics given are not definite enough. It is, however, very closely related to *E. fuscicornis* Cam., which is possibly a synonym. The characters agree so far as given and the distribution offers no difficulty.

Enicospilus purgatus (Say).

Plate I, fig. 6; Plate III, fig. 19.

Ophion purgatus Say, Bost. Journ. Nat. Hist., I, p. 238, n. 1, ♂ ♀, Indiana .....1835.
" *lateralis* Brullé, Hist. Nat. Ins., Hym., IV, pp. 141, 142, n. 9, "la Caroline." .....1846.

Ophion purgatus Say, Le Conte, Writings of Thos. Say, Ent., II, p. 694, n. 1, Indiana.....1859
" " Norton, Proc. Ent. Soc. Phila., I, p. 358, n. 1....1863.
" " Riley, Second Ann. Rept. Ins. Missouri, p. 53, general.....1870.
" " Riley, Idem, p. 53, f. 25.....1870.
" *purgatum* Riley, N. Y. Tribune, Nov. 16.....1875.
" *purgatus* Cresson, U. S. Geog. Surv. Terr. Rept., 5, p. 708, eastern Nevada .....1875.
" " Riley, Eighth Ann. Rept. Ins. Missouri, p. 54, fig. 38.....1876.
" " Packard, Ninth Rept. U. S. Geol. and Geog. Surv., p. 704 .....1877.
" " Packard, Mass. St. Bd. Agr., 25th Rept., p. 252..1878.
" " Provancher, Nat. Can., XI, p. 117, n. 2, ♀ ♂...1879.
" " Thomas, Tenth Rept. State Ent. Ill., p. 41.....1881.
" " Riley, U. S. Ent. Comm., Third Rept., p. 128, pl. 2, fig. 5, life history .....1883.
" " Caulfield, Can. Ent., 16, pp. 122, 123.....1884.
" " " Ent. Soc. Ont., Fifteenth Rept., p. 41..1885.
" " Provancher, Nat. Can., 16, p. 34.....1887.
" " Riley, N. J. St. Bd. Agr., Fifteenth Ann. Rept., p. 524.....1888.
" *purgatum* Fletcher, Cen. Exp. Farm (Canada), Rept., p. 57.....1888.
" *purgatus* Lugger, Univ. Minn. Bienn. Rept. Regents, p. 366, fig. 31.....1888.
" " Provancher, Nat. Can., 19, p. 248.....1889.
" *purgatum* Riley and Howard, Insect Life, II, p. 382, reared from *Scolopteryx libatrix*.....1890.
" *purgatus* Riley and Howard, Insect Life, III, p. 155.....1890.
" *purgatum* Ashmead, Col. Biol. Assn., Bull. I, p. 43.....1890.
" *purgatus* Packard, U. S. Ent. Comm., Fifth Rept., p. 269...1890.
" " Webster, U. S. Dept. Agr., Div. Ent., Cld. sey., Bull. 22, p. 46.....1890.
" *purgatum* Ashmead, Smith's Cat. Ins. N. J., p. 25.....1890.
" " Harrington, Ent. Soc. Ont., Twenty-first Rept., p. 67.....1891.
" " Osborn, Part. Cat. Animals Ia., p. 15.....1892.
" *purgatus* Webster, Ohio Agr. Exp. Sta., Bull. 45, p. 169.....1893.
" *purgatum* Evans, Can. Ent., 28, p. 10.....1896.
" " Lugger, Ent. Minn. Agr. Exp. Sta., Second Rept., p. 10, fig. 17.....1896.
" " Lugger, Minn. Agr. Exp. Sta., Bull. 48, pp. 45–46, fig. 10.....1896.

Ophion purgatus Panton, Ent. Soc. Ont., Twenty-seventh Rept., p. 51 ..... 1897.
Enicospilus purgatus Dimmock, Proc. Ent. Soc. Wash., IV, p. 153, n. 45 ..... 1898.
" *purgatum* Ashmead, Smith's Ins. N. J., p. 580, fig. 274..1899.
Ophion purgatus Dalla Torre, Cat. Hym., III, p. 198 ..... 1901.
Enicospilus purgatus Ashmead, Proc. Wash. Acad. Sci., 28, p. 233, one ♀, Fox Point, Alaska ..... 1902.
Enisocpilus " Felt, Nineteenth Rept. State Ent. N. Y. (N. Y. St. Mus., Bull. 76), p. 108 ..... 1904.
" " Ashmead, Harriman Expedition, Vol. VIII, Part I, Fox Point, Alaska, July 28...1904.
Ophion purgatus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 119 ..... 1905.
Henicospilus purgatus Schulz, Spolia Hymenopterologica, p. 98, n. 198 ..... 1906.
Enicospilus purgatus Viereck, Smith's Ins. N. J., p. 620, fig. 252..1910.

Fulvous, vertex flavous to fuscous; wings hyaline, iridescent, with two maculæ, the larger subtriangular, often with an appendix separated from, but clearly defined below, the smaller macula, which varies in shape from circular to semicircular, and sometimes nearly crescentic.

Length, 14–24 mm.; wing, 11–15 mm.; spread, 23–32 mm.; antennæ, 15–25 mm.

Fulvous, varied with flavous and fuscous; head flavous, occasionally darker, vertex of general color; ocelli large, prominent, well separated, equidistant; antennæ as long as the body, dark flavous; eyes large, emarginate; clypeal foveæ distinct; mandibles bidentate, tipped with black.

Thorax sericeous, smooth, fulvous, tinged with fuscous or ferruginous; mesonotum smooth, frequently more or less tinged with fuscous, parapsidal furrows indistinct; metathorax with a more or less distinct anterior transverse carina, in front of which it is smooth, behind finely rugose and occasionally with distinct carinæ; wings hyaline, iridescent, sometimes tinged with fulvous, stigma flavo-fulvous, nervures slightly darker; basal half of radial vein thickened but narrowed near the stigma; discocubital vein siniate, its bulla scarcely one-fourth the width of the third discoidal from its apex; nervulus antefurcal to interstitial; nervellus broken far below the middle, discocubital cell with two maculæ, the larger subtriangular, often with an appendix separated from it, but distinct below the smaller macula, which varies in shape from circular or semicircular to nearly crescentic—in one specimen it is nearly colorless—while the distance from the larger macula shows considerable variation.

Legs flavous or slightly reddish; claws pectinate.

Abdomen strongly compressed, often darker at the apex; the two basal segments long and slender, subtriangular, obliquely truncate, acute posteriorly.

This description has been prepared after an examination of more than 300 specimens.

Type.—Location unknown.

This species is easily recognized by the two maculæ and often a line, in the discocubital cell, and by the light color of the body. *E. arcuatus* is so closely related to *purgatus* that it can only be considered as a subspecies. It is usually noticeably larger, the larger macula always appendiculate and the bulla of the discocubital vein distant one-half the width of the discocubital cell from its apex, while in *purgatus* it is scarcely one-fourth the width from the apex.

Distribution.—This species ranges from the Boreal Zone in southern Alaska (50° lat.) to the Tropical Zone in Mexico (26° lat.), and the West Indies to Chili in South America. I have before me specimens from Fox Point, Alaska*; Washington; Mt. Hood, Oregon: Santa Cruz Mountains, etc., California; Mexico; Chili; Pinar del Rio, Cuba; Jamaica; Brownsville, Texas; Louisiana; Alabama; Florida; Pennsylvania; Illinois; Colorado; Montana; New Hampshire; Grand Lake, Newfoundland; Winnipeg, etc., Canada. Specimens from many intervening places show that it ranges over most of Canada, all of the United States, south into Mexico, Central America, part at least of the West Indies, and Chili in South America.

This wide distribution led me to expect to find two species, but after careful study I have not succeeded.

Life history.—This is the member of the genus most frequently taken in the United States while collecting in the daytime, and the one most common in collections. The adults fly in Massachusetts from the last of May till the last of September, and farther south occasionally from March to December. They are diurnal and probably crepuscular in habit since they are attracted to light to a certain extent.

* "An Indian village at the extreme southeastern corner of the Alaska mainland, July 26."

The life history has already been discussed on page 14, and need not be repeated here. The cocoons are found in the soil or under shelter near the place where the host has transformed. The fact that many females of this species are taken in trap lantern reduces the value of such traps considerably as a means of combating injurious insects.

Economic importance.—Records seem to indicate that this is one of the most valuable species of the genus, since it preys on several insects of considerable economic importance. It has been frequently reported as parasite of the army worm (*Heliophila unipuncta* Haw.) and Prof. Lugger's report shows that it is a very efficient check to that pest. It has also been reared from the Zebra caterpiller (*Mamestra picta* Harr.) another injurious species, and Dr. Dimmock reports it, Proceedings Entomological Society of Washington, IV, p. 153, 1898—as bred from a pupa of *Prionia bilineata* and of a bombycid.

Hosts.

Alabama (*Aletia*) *argillacea* Hubn.; bred specimen.
Coelodasys unicornis Abb. and Smith, Ins. Life, III, p. 155, 1890.
Cutworm spp.; Riley, Third Rept. U. S. Ent. Comm., p. 128, 1883.
Dipterous Solidago gall; Felt, N. Y. State Mus., Bull. 76, p. 109, 1904.
Heliophila unipuncta Harr.; Idem.
Mamestra picta Harr.; Smith's Ins. N. J., p. 620, 1910.
" *trifolii* Rott; Felt, N. Y. State Mus., Bull. 76, p. 109, 1904.
Scoliopteryx libatrix L.; Felt, Idem.
Schizura concinna Abb. and Smith; Felt, N. Y. State Mus., Bull. 76, p. 109, 1904.
" *unicornis* Abb. and Smith; Idem.
Telea polyphemus Cram.; Idem.
Lepidopterous larva; Insect Life, III, p. 155, 1890.
Falcaria (*Prionia*) *bilineata* Pack.; Proc. Ent. Soc. Wash., IV, p. 153, 1898.
A bombycid moth; Idem.

Location of specimens.—The U. S. National Museum collection contains specimens of this species from Fox Point, Alaska; Canada; Santa Cruz Mountains, Cal.; San Forge, Lower California; Reno, Nevada; Colorado; Arizona; Plano, Cypress Mills, and Victoria, Texas; Milwaukee, Wis.; Agricultural College, Mich,; Illinois; St. Louis, Mo.; Ithaca, and

Flatbush, N. Y.; West Chester, Pa.: Hanover, N. H.; Amherst, Mass.; Washington, D. C.; Vienna, Va.; Tifton, Ga.; Alabama; Chebut Territory, Argentina.

Enicospilus cubensis (Norton).

Plate III, fig. 14.

Ophion cubensis Norton, Proc. Ent. Soc. Phila., I., p. 358, n. 2, ♀, Cuba.....1863.
" " Cresson, Idem, IV, p. 57, "one Cuban specimen from Osten Sacken, Cole."....1865.
" " Ashmead, Journ. Linnean Soc. Zool., XXV, p. 58, listed Isl. St. Vincent....1894.
Enicospilus cubensis Ashmead, Trans. Ent. Soc. Lond., p. 270, n. 180; p. 354, Isl. Grenada, etc ....1900.
Ophion cubensis Dalla Torre, Cat. Hym., III, p. 189....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 95....1905.

Fulvous, apex of abdomen fuscous or black, stigma and nervures flavous; discocubital cell with two maculæ, the smaller crescentic, upright, with indistinct appendix; antennæ fulvous, with apices black.

Length, 14–18 mm.; wing, 12–14 mm.; spread, 25–30 mm.; antennæ, 18–21 mm.

Light reddish-yellow, clothed with fine short pubescence; vertex fulvous, sometimes tinged with black; ocelli large, prominent, well separated; eyes large, slightly emarginate; antennæ long, slender, the apex black; face with a short, median, longitudinal carina below the antennæ; fossæ sometimes piceous; clypeal foveæ distinct. Mesonotum with three broad, more or less distinct fuscous stripes; thoracic sutures, pleuræ, and pectus ferruginous to black;* pleuræ marked with flavous; scutellum convex, honey-yellow; metathorax with a weak anterior transverse carina, in front of which it is smooth, behind very finely reticulate, with weak median and lateral longitudinal carinæ.

Wings hyaline, stigma and costa flavous, nervures otherwise fuscous; radial vein with its basal half slightly thickened; discocubital vein bent, its outer half nearly parallel with the third discoidal vein; discocubital cell with two maculæ, the larger triangular, not appendiculate, or only slightly so, the smaller upright, crescentic, its horns pointed outward, and with a colorless appendix; nervulus interstitial; nervellus broken below the middle.

Legs fulvous, claws pectinate.

Abdomen with the four basal segments fulvous or slightly lighter, the rest fuscous or black.

* Norton states that in the types the pectus, thoracic sutures, mesothorax and three apical abdominal segments are piceous, but this is not so in the specimens which I have seen.

In describing this species I have examined a cotype,* two ♀ and one ♂ specimens.

Cotypes.—Three ♀'s, location unknown to me.

This species resembles *E. flavus* in size and structure, but the shape of the maculæ and color of the vertex differ.

Distribution.—This species is tropical, having been reported from the Islands of Cuba, St. Vincent, Grenada, Porto Rico and Jamaica, and probably ranges through the rest of the Antilles and possibly to central and tropical South America.

Nothing is known of the life history, habits or hosts.

Location of specimens.—American Entomological Society (Philadelphia), ♂ homotypes?, No. 79; two ♀ and one ♂ specimens, Cuba. American Museum Natural History, ♀ cotypes? or homotypes, Cuba. U. S. National Museum, Cayamas, Cuba; Aguadilla, Porto Rico; St. Vincent.

Enicospilus flaviceps (Br.).

Ophion flaviceps Brullé, Hist. Nat. Ins., Hym., IV, p. 142, n. 10, Brazil.....1846.
" " Dalla Torre, Cat. Hym., III, p. 190.....1901.
Henicospilus flaviceps Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 27, n. 55.....1905.

Rufous, head flavous, sides of abdomen fuscous; mesonotum faintly trilobate; stigma yellowish, discocubital cell with two yellowish maculæ.

Length, 20 mm.

Rufous, with head yellow; mesonotum faintly trilobate, without distinct brown lines; metathorax with anterior transverse sinuous carinæ, a little emarginate in the middle, behind this strongly punctured, the base with fine longitudinal striæ. Wings hyaline, stigma yellowish, discocubital cell with two yellowish maculæ; nervures brown in the primary, red in the secondary region.

Abdomen a little spotted with brown on the sides below, the border of the segments a little yellowish.

* There is in the American Entomological Society Collection a male specimen of this species presented by Osten Sacken on or before 1868 and labelled by him; as the three ♀ cotypes were in his collection this is probably a homotype. A female specimen in the American Museum of Natural History is also from the Osten Sacken collection and labelled by him, hence probably of similar standing or a possible cotype.

I have not seen a specimen of this species, and can only give a free translation of Brullé's description.

Type.—Location unknown.

Distribution.—Brazil.

Table of Additional Species.

1. Stemmaticum (vertex between eyes) not black.....2.
   Stemmaticum black.....4.
2. Thorax red; stigma and abdomen beyond the third segment black; wings light brown; mesopleuræ dull..... **fuscatus** Szep.
   Thorax reddish-yellow, often spotted with white and black; stigma pure yellow.....3.
3. Discocubital cell with *one* macula.....**narvifasciatus** Cam.
   Discocubital cell with *more than one* macula.....11.
4. Abdomen wholly black.....**elegans** Szep.
   Abdomen not wholly black.....5.
5. The fourth segment of the abdomen black.....6.
   The fourth segment of the abdomen not black.....10.
6. Anterior wing with *one* macula .....**szepligeti** n. n.
   Anterior wing with *two* maculæ.....7.
7. Stigma yellow.....8.
   Stigma brown to black.....9.
8. Nervulus antefurcal; antennæ not much longer than the body; mesopleuræ not spotted with black...**xanthocarpus** Szep.
   Nervulus postfurcal; antennæ nearly twice as long as the body; mesopleuræ spotted with black.....**xanthostigma** Szep.
9. Wings light brown, the second smaller macula round. **fuscipennis** Szep.
   Wings almost hyaline, the second smaller macula longish. **persimilis** Szep.
10. Stigma yellow; metanotum finely rugose; abdomen beyond the fifth segment black to brownish.....**brasiliensis** Szep.
11. Discocubital cell with *two* maculæ.....12.
    Discocubital cell with *three* maculæ.....**trispilus** Szep.
12. Larger macula appendiculate.....**dispilus** Szep.
    Larger macula not appendiculate.....13.
13. Smaller macula circular.....**volubilis** Holm.
    Smaller macula not circular .....**guyanensis** Cam.

Enicospilus brasiliensis (Szep.).

Henicospilus brasiliensis Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, pp. 147, 148, ♀.....1906.

"Head narrow and sloping behind the eyes; antennæ as long as the body; mesonotum shining; propleuræ striped; mesopleuræ rugose, punctate only below; metanotum somewhat finely and uniformly

rugose; wings with one macula; nervulus slightly postfurcal; second segment (of abdomen ?) as long as the first, reddish-yellow; stemmaticum (vertex) of abdomen from the fifth segment on and the fourth segment behind, at the sides, black; pleuræ spotted with yellow; head and scutellum yellow, stemmaticum (vertex) black; wings hyaline, veins black, stigma yellow.

"Length, 22 mm."

I have not seen a specimen of this species, and can only give a free translation of the original description.

Distribution. — Minas Geraes, Brazil. Var. ♀ : size only 15 mm., Blumenau, Brazil,

Enicospilus parvifasciatus Cam.

Enicospilus parvifasciatus Cameron, Jour. Royal Agr. and Commer. Soc., British Guiana, I, p. 180...1911.

Length, 18 mm.

"Luteous, the head yellow, the thorax paler, more yellowish in tint, the antennæ more rufous, the apical abdominal segments darker than the basal; three large broad black marks on the mesonotum, a black mark on the apex of the mesopleuræ, commencing near the top and reaching below nearer to the bottom, it becomes gradually widened from the top to the bottom, with the apex and lower side straight; the legs paler in tint than the body; wings hyaline, a small triangular cloud, longer than it is wide at the apex, filling the base of the radial cellule, the costa rufo testaceous, the stigma and nervures black; the recurrent nervure separated from the transverse cubital by four times the length of the latter; the basal abscissa of the radius is thickened to the middle; the transverse median nervure interstitial. The base of metanotum is smooth; the upper part of the apical part is smooth, except for a straight and two curved striæ in the center; the rest strongly, closely transversely striated. There is only one horny point in the forewings; it is conical, longer than it is wide at the apex; the top narrowed, rounded end at the base, the apex transverse except for a small projection on the lower edge. Female."

Distribution.—British Guiana,

Location of specimens. — Georgetown Museum. British Guiana.

Enicospilus dispilus (Szep.).

Henicospilus dispilus Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, p. 145, ♀.....1906.

"Head narrow and sloping behind the eyes. Antennæ as long or longer than the body. Mesonotum somewhat shining. Pro- and mesopleuræ finely and indistinctly punctured, shining; metapleuræ leath-

ery; mesonotum quite finely wrinkled, the basal part smooth. Wings with two maculæ, the larger with broad crescentic appendix, the smaller is round; nervulus antefurcal. Second segment (of abdomen ?) longer than the first, reddish-yellow; mesonotum with three brown spots; wings hyaline, veins and stigma reddish-yellow.

"Length, 25 mm."

I have not seen a specimen of this species, and can only give the original description. It is apparently closely related to *E. Volubilis* Holm.

Distribution.—Minas Geraes, Brazil.

Enicospilus guyanensis Cam.

Enicospilus guyanensis Cameron, Journ. Royal Agr. and Commer. Soc., British Guiana, I, pp. 179, 180.....1911.

Length (not given).

"Luteous, the head pallid yellow, the antennæ of a deeper, more rufous color, wings hyaline, the stigma and nervures ferruginous, the apical nervures darker in tint, the basal horny point large, transverse below, the top basal half roundly widened from the base upwards, the smaller, apical half oblique on the upper two-thirds, the lower projecting into a point, which becomes gradually narrowed towards the apex, the second point is small, its apex broad, rounded, the lower edge rounded, the upper rounded inwardly; the apical abscissa of the discocubital nervure fully one-third longer than the transverse cubital, which is rounded. Basal half of the scutellum with a shallow furrow down the middle; the apical slope with two long and two short stout striæ. Metanotum with irregular longitudinal striæ in the middle of the base, the sides more strongly obliquely striated, the apex with rounded striæ. The middle of mesopleuræ broadly, finely obliquely striated, the striæ stronger on the lower half. Except on the basal and lower parts the metapleuræ are finely striated and punctured. There is a broad black mark in the middle of the seventh abdominal segment on the sides."

Closely related to *E. dispilus* Szep.

Distribution.—British Guiana.

Location of specimens.—Georgetown Museum, Timehri, British Guiana.

Enicospilus elegans (Szep.).

Henicospilus elegans Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, p. 146, ♀.....1906.

"Head smooth, narrow and sloping behind the eyes; face almost parallel, clypeus rounded and not separated. Antennæ longer than the body. Mesonotum black, wrinkled; propleuræ with bands of

wrinkles, scutellum bordered, mesopleuræ weakly wrinkled below, metanotum with a single keel-like longitudinal wrinkle on the side, the middle wrinkled below transversely. Wings with two maculæ, the larger without appendix; nervulus antefurcal, nervus parallelus inserted rather higher, nervellus broken wholly below the middle. Claws pectinate. Second segment (of abdomen?) somewhat longer than the first.

"Red; antennæ, ocelli, posterior legs from the femur on and abdomen, black.

"Length, 22 mm."

I have not seen a specimen of this species, and can only give a free translation of the original description.

Distribution.—Blumenau, Brazil.

Enicospilus fuscatus (Szep.).

Henicospilus fuscatus Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part 1, p. 145, ♀.....1906.

"Head obliquely narrowed behind the eyes; mesonotum dull; pleuræ leathery, finely wrinkled and dull; metanotum with strong arcuate wrinkles. The anterior macula without appendix, the posterior not colored, nervulus antefurcal; second segment of abdomen somewhat shorter than the first.

"Reddish yellow; antennæ and abdomen beyond the third segment, black. Wings light brown, nervures and stigma, black.

"Length, 25 mm."

I have not seen a specimen of this species, and can only give a free translation of the original description.

Distribution.—Blumenau, Brazil.

Enicospilus fuscipennis (Szep.).

Henicospilus fuscipennis Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, p. 147, ♀.....1906.

"Similar to *H. fuscatus* except the stemmaticum (vertex) black and the anterior wings with two maculæ; metanotum somewhat coarsely wrinkled; head yellowish.

"Length, 25 mm."

Distribution.—Minas Geraes, Brazil; Mapiri, Bolivia.

"Var. Metanotum, arcuate or obliquely wrinkled."

Distribution.—Blumenau, Brazil; Mapiri, Bolivia.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Enicospilus szepligetii n. n.*

Henicospilus seminiger Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, p. 146, ♀.....1906.

"Mesopleuræ smooth and shining; metanotum somewhat finely wrinkled. One macula, nervulus interstitial. Reddish-yellow; stemmaticum (vertex) and abdomen from the middle of the third segment on, black; antennæ brown; wings light brown, stigma yellow.

"Length, 18 mm."

Distribution.—Sao Palo, Brazil.

"Var. ♀. Scutellum yellow, thorax spotted with yellow, mesonotum with three brown stripes, the third segment of abdomen, almost entirely black, base of antennæ red.

"Length, 20 mm."

Distribution.—Mapiri, Bolivia.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Enicospilus trispilus (Szep.).

Henicospilus trispilus Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, p. 145, ♂.....1906.

Similar to *E. dispilus*.

"Anterior wings with three (more or less distinct, maculæ, the larger macula and its appendix not connected, the smaller pale and longish. Metanotum with weak carinæ along the middle. Reddish-yellow; thorax yellow spotted, scutellum yellow, mesonotum with three brownish spots, metanotum with a light brown transverse spot in the middle, and with two similar spots on the lower half of the post-scutellum; abdomen light brown mottled, from the fourth segment on with a light spot on the side. Wings hyaline, stigma yellow, veins yellowish.

"Length, 22 mm."

Distribution.—Merida, Venezuela.

I place here a male from Mexico in which the brownish marks appear indistinct.

"Var. ♂. The yellow and black marks are sharply outlined. Wings brownish, towards the base yellowish, veins black; segments one to three brown at the ends, apical segments from the fifth on brown. The furrow between mesopleuræ and mesopleuræ strongly punctured."

Distribution.—Mapiri, Bolivia.

I have not seen a specimen of this species, and can only give a free translation of the original description.

* Szepligeti describes in the same volume with this, but eleven pages before, *Enicospilus seminiger* n. sp. from East Africa; this is, therefore, a synonym, and I propose the name *E. szepligetii* to take its place.

Enicospilus xanthocarpus Szep.

Henicospilus xanthocarpus Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part I, p. 146 ♀.....1906.

"Head narrow behind the eyes. Antennæ somewhat longer than the body; mesopleuræ rather smooth; metanotum finely wrinkled. Two chitinous spots, the smaller elliptical; nervulus antefurcal. Reddish-yellow; head and scutellum yellow, stemmaticum black, thorax spotted with yellow, mesonotum with three black spots, abdomen from the fourth segment on, and antennæ black. Wings almost hyaline, veins black, stigma yellow."

Length, 18 mm.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Distribution.—Mapiri, Bolivia.

Enicospilus xanthostigma Szep.

Henicospilus xanthostigma Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., Part 1, p. 147.....1906.

"Similar to *E. xanthocarpus*. Antennæ almost twice as long as the body; mesopleuræ somewhat wrinkled. The smaller maculæ long and almost S-shaped. Basal half of the antennæ reddish-yellow. Mesopleuræ spotted with black, breast black."

Length, 25 mm.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Distribution.—Blumenau, Brazil.

Enicospilus volubilis (Holm.).

Ophion volubilis Holmgren, Eugenies Resa Insect, p. 410, n. 42, Argentina, ♂ ♀.....1868.
" " Dalla Torre, Cat. Hym., III, p. 200.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 112.....1906.

Rufous; head flavous; apex of abdomen sometimes fuscous; discocubital cell with two maculæ.

Length, 14 mm.

Head flavous, transverse, not buccate, narrowed behind the eyes; frons very short; face narrower, not elevated; clypeus clearly defined, slightly raised; the small foveæ drawn out on both sides at the base, apex truncate; labrum slightly exserted; mandibles slender, curved, teeth of unequal lengths, the lower longer; eyes large, oblong, distinctly emarginate at the base of the antennæ; antennæ nearly as long as the body, apex of the scape lost.

Thorax with the dorsum slightly leathery, not shining; mesothorax oblongate, in the female trilobate, pleuræ with a raised ridge; scutellum elongate-triangular, almost entirely emarginate, punctate; metathorax gradually sloping towards the apex, finely rugose, spiracles elongate, located near the base.

Abdomen compressed; first segment straight, a little shorter than the thorax, postpetiole nearly half as long as the petiole; the second segment about equal in length to the first, towards the base slightly curved; the remaining segments compressed, pubescent, noticeably shorter; ovipositor very short.

Wings moderately broad; externalradial well curved, internal incrassate before the base; discocubital cell with two membranous maculæ—yellow in the female—of which the interior is somewhat larger, subtriangular, the exterior large, circular; the transverse discoidal vein broken, the anal below the middle, the latter giving off a distinct vein from the fracture; the interior cubital vein interstitial, very little curved.

Feet slender; tarsal claws thickly and distinctly pectinate.

Female.—Head entirely flavous; antennæ rufous, apex ferruginous; thorax rufous, pleural sutures pale; abdomen rufous, segments 4 to 7 more or less fuscous. Wings hyaline, stigma and membranous maculæ flavous; radix and squamula rufous. Feet fulvorufous.

Male.—Similar to the female, but the apex of the abdomen not fuscous.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Types.—♀ and ♂. Location unknown.

This species has hitherto been retained in the Genus *Ophion*, but the thickening of the base of the radial vein and presence of maculæ place it at once in the Genus *Enicospilus*. The description, though long, is a little indefinite, and it has not been referred to since the original description except in catalogues.

Distribution.—Buenos Ayres, Argentina.

Genus **OPHIOPTERUS** Br.

Ophiopterus Brullé, Hist. Nat. Ins., Hym., IV, p. 153.....1846.
" Cresson, Proc. Acad. Nat. Sci. Phila., p. 380.....1873.
" Cameron, Biol. Centr. Amer., Hym., I, p. 296.....1886.
Ophionopterus Ashmead, Proc. U. S. Nat. Mus., No. 1206, pp. 87, 180 (Vol. 23, 1901).....1900.
Ophiopterus Dalla Torre, Cat. Hym., III, p. 180.....1901.
" Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 37.....1905.
" Schulz, Spolia Hym., p. 96.....1906.
" Schmiedeknecht, Opusc. Ichn. Fasc., XVIII, p. 1424, n. 81.....1908.

Metathorax globular, produced behind into a neck which receives the first abdominal segment; nervellus straight, claws pectinate;* abdomen compressed, slender; base of radius not enlarged, discocubital vein arcuate, not appendiculate.

Brullé gives the following generic description:

"Wings wholly resembling those of *Ophion* and *Thyreodon*. The peculiar form of the metathorax will not allow it to be placed with either the one or the other of the two preceding. *Ophiopterus* has the metathorax globular and terminated by a sort of neck which receives the base of the first segment of the abdomen. The antennæ are long, slender, filiform and similar, according to the form and pattern of coloration, to the antennæ of most species of *Cryptus*. Their joints are longer than wide, and the first is quite truncate on the outer side. The legs are very long and slender. The claws of the tarsi are short, the pulvillus is quite small. As in *Ophion* the clypeus is without a projection or tooth in the middle. The mandibles are very narrow.

"The abdomen is long and compressed or sharp edged (tranchant) beginning at the third segment; segments one and two are narrow.

"The ovipositor of the female is of medium length."

Generic type.—O. coarctatus Br., ♀ (monotypical). Location unknown.

This genus was erected by Brullé for a single species from South America. Since that time four others have been described, one by Cresson and three by Cameron. In 1900 Ashmead tried to improve the generic name by adding an *on*, *Ophionopterus*, but this emendation can not be accepted.—International Code, Art. 19.

A distinct genus, easily recognized by its globular metathorax produced into a neck behind, and its straight nervellus. The venation of the anterior wing closely resembles that of *Thyreodon* and *Athyreodon*, but the straight nervellus

* Dr. Ashmead states (Proc. U. S. Nat. Mus., No. 1206, pp. 86, 87, Vol. XXIII, 1901), that the claws are not pectinate, but none of the descriptions of the genus or tribe mention this character, and I can not learn of the source upon which he drew for such a statement. I have seen only one species—*O. ferrugineus*—but the cotype and four specimens have pectinate claws. As pectinate claws are present in all genera but one in the tribe—*Retanisia*—and this may prove to belong elsewhere, I do not see how Dr. Ashmead's statement can be accepted without further evidence. Szepligeti evidently accepts this, however.

of the posterior wing separates it at once. The wings—in *O. ferrugineus* at least—are comparatively shorter, and their ends more rounded than in any other member of the tribe which I have seen. The members of the genus are not well known, and I can find but one reference to them since the original descriptions.

Distribution.—This is a strictly American genus with only a few species which range from Texas to Brazil. The generic type—*coarctatus*—came from Brazil, but all the other species taken have been reported from Texas and Mexico only. Records and specimens of the various species are so few that no idea of the exact range of any of them can be given.

Nothing has been recorded of the life history, habits or hosts of any member of this genus.

Variation.—One specimen of *O. ferrugineus* Cress. in the U. S. National Museum shows a slight variation or abnormality in venation; in both anterior wings there is a short stub of a vein—½ mm. long—extending into the fourth submarginal cell, about 1 mm. from the outer end of the radial vein.

Table of Species.

1. Body ferruginous.....**ferrugineus** Cress.
   Body black. .....2.
2. Wings fuscous.....**niger** Cam.
   Wings hyaline .....3.
3. Antennæ short, not longer than the head and thorax; wings long; abdomen black.....**fuscipes** Cam.
   Antennæ not short, reaching to the middle of the abdomen.....4.
4. Wings short, not half the length of the abdomen; basal half of abdomen yellow.....**stratifrons** Cam.
   Wings not short, abdomen entirely black.....**coarctatus** Br.

Ophiopterus ferrugineus Cress.

Plate III, figs. 17, 18.

Ophiopterus ferrugineus Cresson, Proc. Acad. Nat. Sci. Phila., p. 380, ♀, Mexico.....1873.
" " Cameron, Biol. Centr. Amer., Hym., Vol. I, p. 296, listed Orizaba, Mex .....1886.
? *Nototrachys annulicornis* Ashmead, Proc. U. S. Nat. Mus., Vol. XII, p. 422, ♂, Texas.....1890.
" " Dalla Torre, Cat. Hym., III, p. 178, listed.....1901.

Ophiopterus ferrugineus Dalla Torre, Idem, p. 180, listed.....1901.
Nototrachys annulicornis Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 20, n. 5, listed.....1905.
Ophiopterus ferrugineus Szepligeti, Idem, p. 37, n. 2, listed.....1905.

Ferruginous to fulvous; ocelli small; antennæ with narrow yellowish white band near the apex, base fulvous, clothed with fine white pubescence.

Length, 12–18 mm.; wing, 8–9 mm.; spread, 17–20 mm.; antennæ, 12–18 mm.; ovipositor, 5 mm.

Ferruginous to fulvous; head and thorax clothed with fine white pubescence, with coarse raised punctures; sides of face and posterior orbits yellowish, head slightly produced behind the eyes and bordered with a keel; eyes and ocelli black, eyes not emarginate, ocelli small, well separated from each other and from the tops of the eyes; antennæ as long as the body, filiform, dark ferruginous to fuscous, with yellowish-white band about 5 mm. from the apex, base fulvous; face broad, coarsely punctured; clypeal foveæ distinct; mandibles bidentate, tipped with black.

Thorax of the general color, sutures distinct.

Mesonotum and scutellum separated by a black transverse furrow, in one case with three weak transverse carinæ; mesopleuræ with a small black spot below the base of the wings.

Metathorax globular, finely reticulate, produced behind into a neck two-thirds the length of the hind coxæ, with two more or less distinct dorsal areolets at the insertion of the abdomen; wings hyaline, faintly dusky at the tips; stigma and nervures fuscous; discocubital nervure arcuate, first recurrent vein about two-thirds the length of the second; radial vein not enlarged, its outer end bent upward; radial vein of hind wing becoming indistinct about 1 mm. beyond its union with the transverse cubital vein.

Legs pale ferruginous, the four anterior tarsi more or less yellowish, posterior tarsi, and in some cases the claws, black; with the second and part of the third joints whitish-yellow; posterior coxæ greatly elongate, three times the length of the anterior; trochanters elongate, the four posterior ones half the length of their femora; claws pectinate.

Abdomen long, very slender, strongly compressed, often lighter than the rest of the body, but slightly fuscous above, especially on the second segment; sheath of the ovipositor black, ovipositor moderately long.*

* Cresson describes the ovipositor as very short, but in his ♀ type it is only slightly exserted, being partly enclosed in the sheaths; where fully exserted it is seen to be longer and more slender than in most American members of this tribe.

Redescribed from ♀ type, three ♀ paratypes and four specimens.

Type.—♀. No. 80, Mexico, American Entomological Society (Academy of Natural Sciences, Philadelphia).

Paratypes.—Three ♀'s. No. 80, Mexico, American Entomological Society (Academy of Natural Sciences, Philadelphia).

A distinct species, easily recognized by the ferruginous color of the body, the others being black.

In 1890 Ashmead described *Nototrachys annulicornis*, placing it temporarily in the Genus *Nototrachys*, but practically saying that he did not know where it belonged. Comparison of his type with the type of *ferrugineus* Cress. shows that they are synonymous. The small third tibial spur which Dr. Ashmead mentions seems to be absent. Dr. Ashmead later recognized that his species belonged in this genus, as his labels show, but failed to identify it with *ferrugineus* Cress.

Distribution.—Illinois; Texas; Orizaba, Mexico.

The type of this species came from Mexico; there are four specimens in the U. S. National Museum from Texas. Cameron reports it from Orizaba, Mexico (19°). So far as known it comes from the Upper and Lower Austral zones. It probably ranges south into Central America, but as there are no records of its capture there the exact range can not be determined.

I can find no reference relative to life history, habits or hosts. The specimens in the U. S. National Museum were taken December 26 in Texas.

Location of specimens.—Type ♀, No. 80, Mexico, American Entomological Society (Academy of Natural Sciences, Philadelphia). Paratypes, three ♀'s, No. 80, Mexico, American Entomological Society (Academy of Natural Sciences, Philadelphia). Homotype, ♀, No. —, Texas; Illinois; U. S. National Museum, cotype, No. 2054, of *Nototrachys annulicornis* Ashm. Homotype, three female specimens, U. S. National Museum, cotype, No. 2054, of *Nototrachys annulicornis* Ashm.

Ophiopterus niger Cam.

Ophiopterus niger Cameron, Biol. Centr. Amer., Hym., Vol. I, p. 296, n. 2, Hurchihuitle, Mexico; original description, ♂.....1886.
" " Dalla Torre, Cat. Hym., III, p. 180, listed.....1901.
" " Szepligeti Gen. Ins., Hym., 34me Fasc., p. 37, n. 4, listed.....1905

Black; wings nearly fuscous. ♂.

Length, 16 mm.

"Head semiopaque, covered with a depressed pile; a longitudinal keel running down from the ocelli, and from it short striations proceed on either side; thorax finely punctured, a smooth, shining, impunctate space beneath the wings; pronotum at the sides obliquely striated; mesopleuræ at the edges longitudinally striated; mesonotum in front of the scutellum reticulated; metathorax coarsely reticulated; abdomen three times the length of the thorax, shining, impunctate; the three basal segments cylindrical, narrow, the second segment the longest."

I have not seen the type or a specimen of this species and can only give Cameron's description.

Type.—♂. British Museum.

Distribution.—The type came from Hurchihuitle, Mexico, and I can find no other records of capture.

Ophiopterus fuscipes Cam.

Ophiopterus fuscipes Cameron, Biol. Centr. Amer., Hym., Vol. I, p. 296. n. 1, Orizaba, Mexico.....1886.
" " Dalla Torre, Cat. Hym., III, p. 180, listed...1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 37, n. 3, listed.....1905.

Black; face, mouth, eyes, pronotal lines, tegulæ, scutellum and base of abdomen flavous; feet fuscous, pale in front; wings hyaline, nervures black; antennæ short, pale yellow beneath.

Length, 12 mm.

"Densely covered with silvery-white pubescence, densest on the pleuræ. Head finely punctured; antennæ short, not much longer than the head and thorax together, the scape pale yellow beneath. Pronotum obliquely, the mesonotum transversely and very strongly, striated, the striations widely separated; a shining impunctate space below the hind wings on the mesopleuræ; the rest strongly longitudinally striated, running at the edges into reticulations; scutellum shining, nearly impunctate; metathorax coarsely reticulated and leaving a gradual slope to the apex.

"Abdomen shining, impunctate, covered with a pale close pile; black, the sides from the third segment obscure rufous; sheath of ovipositor black. Legs in greater part fuscous covered with a pale pile; the femora inclining to rufous on the lower side; the fore legs almost entirely, and the middle legs in front, pallid testaceous."

I have not seen specimens of this species, and can only give Cameron's description without remarks.

Type.— ♀. Location unknown.*

Distribution.—The type of this species was taken at Orizaba, Mexico, but there are no other records of capture, hence the range is unknown.

Ophiopterus striatifrons Cam.

Ophiopterus striatifrons Cameron, Biol. Centr. Amer., Hym., Vol. I, p. 297 (♂ ♀), Cuidad in Durango, Mexico.....1886.
" " Dalla Torre, Cat. Hym., III, p. 180.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., pp. 37, 215.....1905.

Black; mouth, eyes broadly, tegulæ, anterior coxæ, and base of abdomen flavous, feet rufous; wings very short, hyaline, nervures black.

Length, 9–10 mm.

Antennæ about half the length of the abdomen, microscopically pilose; fuscous towards the base of the flagellum, the basal joint of the scape yellow on the underside. Head black; the mouth, mandibles, palpi, orbits (broadly on the inner, narrowly on the outer, side) and the face (except a triangular black mark), yellow; face and vertex finely punctured; the front transversely, and the head behind at the sides longitudinally and strongly, striated; an indistinct keel runs down from the ocelli and another from each antenna down the face.

Thorax black; a broad line on each side of the mesonotum in front close to the pronotum, the tegulæ and the scutellum in the center, yellow; mesonotum strongly transversely striated in front, punctured in the middle, aciculated behind; prothorax obliquely striated at the sides, except in the middle, which is shining and impunctate; pronotum roughly transversely striated; mesopleura (except below the wings) and sternum rugose; scutellum punctured, the lateral keels stout; metathorax coarsely reticulated. Abdomen twice the length of the head and thorax united; the greater part of the basal half yellow, fourth and fifth segments rufous; wings not half the length of the abdomen.

Legs reddish, the four anterior coxæ and trochanters yellow; the

* Not in the British Museum, but a MSS. states that it is "in the Vienna Museum."

hind coxæ and trochanters black, yellow at their junction, the base of the hind femora and apices of the tibia and tarsi black. In most of the specimens the hind femora and tibiæ incline to fuscous or black, perhaps owing to discoloration.

I have not seen a specimen of this species, and can only give Cameron's description.

Types.— ♀ and ♂. Location unknown.*

Distribution.—The type was taken at Ciudad in Durango, Mexico.

Ophiopterus coarctatus Br.

Ophiopterus coarctatus Brullé, Hist. Nat. Ins., Hym., Vol. IV, p. 153, pl. 42, fig. 5, Guaratuba, Brazil.....1846.
" " Dalla Torre, Cat. Hym., III, p. 180, listed..1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 37, n. 1, listed.....1905.

Black; antennæ with wide, dirty white band near the apex; four anterior tibiæ and tarsi in part, flavous.

Length, 23 mm.; ovipositor, 4 mm.

Black; head rugose or strongly punctured with the face a little projecting in the middle; antennæ with wide flavous annulus near the apex; prothorax rugose above and below; pro- and mesopleuræ punctured; median lobe of mesonotum punctured in front, projecting and compressed, behind rugose or transversely striated, edges of lateral lobes punctured, slightly projecting and pointing backward; mesopleuræ smooth in the middle, strongly punctured below; scutellum rugose, slightly enlarged behind; metathorax strongly rugose—"the arrangement of the wrinkles imitating small scales"—the second region represented by two semicircular lobes, raised at the edge.

Wings transparent, nervures black.

Four anterior legs mostly dirty white, the inner surface black or brown; tarsi partly brown; two anterior femora ferruginous; second and third segments of posterior tarsi whitish.

Abdomen compressed from the third segment on; valves of ovipositor arcuate, the posterior two-thirds a little enlarged.

I have not seen a specimen of this species, and can only give a translation of Brullé's description.

Type.— ♀. Location unknown.

Distribution.—I find no reference to this species since the original description, the type of which was taken at Guaratuba, Brazil.

* Not in the British Museum, but a MSS. states that "Mr. Cameron retained the specimens."

Genus **ATHYREODON** Ashm.

Athyreodon Ashmead, Proc. U. S. Nat. Mus., No. 1206, p. 87, n. 645 (Vol. XXIII, 1901).....1900.
" Faun. Hawaiiensis, Vol. I, Part 3, p. 343.....1901.
Tipulophion Kriechbaumer, Zeitschr. Hym. Dipt., I, p. 75, March 1.....1901.
Athyreodon Ashmead, Faun. Haw., I, p. 343, August 1.....1901.
" Dalla Torre, Cat. Hym., III, p. 185.....1901.
Tipulophion Schulz, Zeitschr. f. Syst. Hym. Dipt., III, p. 252.....1903.
Macrophion Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32.....1905.
Tipulophion Schulz, Spolia Hym., p. 97, n. 186.,.....1906.
Macrophion Schmiedeknecht, Opusc. Ichn., XVIII, p. 1420.....1908.

Ocelli large, close to the tops of the eyes; wings without stigma; discocubital vein arcuate, not appendiculate; nervellus broken above the middle; antennæ long, filiform; claws pectinate.

Generic type.—*A. atriventris* Cress.

The members of this genus are closely related to those of *Thyreodon*, but may be readily recognized by their large ocelli. These vary slightly in size, but are always much larger than in *Thyreodon* and considerably larger than in *Ophion*. In some species the ocelli are close to each other and also to the tops of the eyes, almost filling this space; in others they are well separated from each but near the eyes. The other characters are as in *Thyreodon*. This difference from members of the Genus *Thyreodon* has been recognized by three different workers, and, strange enough, in the same species, *atriventris*, though none of the three recognized this fact; each proposed a new genus and described his species as new. It will, therefore, be readily seen that there is some variation within this species. The size of the fuliginous spots in the wings varies, at least in *atriventris*, and probably in other members of the genus, but how widely is not known. Dalla Torre's statement that *Athyreodon* is mentioned in the Transactions of the Entomological Society of London, p. 87, 1900, is a mistake, and he evidently confused it with the Proceedings of the U. S. National Museum, No. 1206, p. 87, 1900.

Distribution.—The members of this genus are apparently tropical with a wide distribution from Mexico to southern Brazil, including the West Indies. *A. atriventris* ranges over

all of this territory, but so far as is now known the others have a more restricted distribution.

The species which compose this genus are large, bright colored insects, conspicuous in any collection. Nothing is known of their life history, habits or hosts, but these probably differ but little from those of the closely related Thyreodons.

Table of Species.

1. Flagellum of antennæ and abdomen black, with or without cyaneous reflection.....2.
   Flagellum of antennæ and abdomen *not* black.....4.
2. Legs and mesonotum entirely black.....**fenestratus** Tasch.
   Legs and mesonotum *not* entirely black, four anterior legs more or less flavous.....3.
3. Wings with apical fuliginous band in both.....**apicalis** Szep.
   Wings with apical fuliginous band, radial and median cells more or less black.....**atriventris** Cress.
4. Apex of wings fuscous.....**fulvescens** Cress.
   Part of radial and marginal cells and stripe along basal vein black. **armstrongi** n. sp.

Athyreodon fenestratus (Tasch.).

Ophion fenestratus Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 425, n. 4, ♀.....1875.
" " Dalla Torre, Cat. Hym., III, p. 190.....1901.
Macrophion fenestratus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 33, n. 1, pl. 2, fig. 13.....1905.
Thyredon " Szepligeti, Idem, p. 25, n. 7.....1905.
Macrophion " Schulz, Spolia Hym., p. 97.....1906.

Cyaneous; mesonotum and abdomen black with a bluish reflection; mesopleuræ and pectus sanguineous, wings fulvoferruginous with a large subhyaline nearly transparent spot in the discocubital and discoidal cells.

Length, 26-30 mm

Eyes and ocelli large; antennæ black; frons and clypeus densely and finely punctured; frons rugose, with a median keel extending below the base of the antennæ; clypeus rounded in front.

Thorax smooth and shining; mesonotum and metathorax black; mesopleuræ, mesosternum and sometimes the metapleuræ sanguineous; mesonotum with parapsidal furrow distinct; metathorax rugose. Wings fulvofuscous, with a large subhyaline almost transparent spot in the discocubital and discoidal cells; nervulus postfurcal to interstitial, nervellus broken well above the middle; discocubital vein arcuate, stigma lacking. Legs black. Abdomen black, with a cyaneous reflection, strongly compressed.

I have not seen a specimen of this species, and can only give a free translation of the original description with additions from Szepligeti's description.

Type.—♀. Location unknown to me.

This species was first described as *Ophion fenestratus* by Taschenberg from a female from Rio de Janeiro, and later redescribed as *Macrophion fenestratus* Szepligeti, a supposedly new species, from a male from Espirito Santo, Brazil. Mr. W. A. Schulz treats *M. fenestratus* Szep. and other male specimens of this species as "the hitherto unknown males of *Tipulophion rufithorax*" (*A. atriventris*), but this is apparently a mistake, for they agree with the female of *fenestratus*, while the difference from *A. atriventris* is quite marked.

Distribution.—Rio de Janeiro, Espirito Santo, Brazil.

Athyreodon apicalis (Szep.).

Macrophion apicalis Schmiedeknecht, Opusc. Ichn., XVIII, p. 1420.....1908.

Ferruginous; vertex, antennæ and posterior legs black; abdomen bluish-black; wings, apical third of the anterior wing and apex of the posterior brown.

Length, 30 mm.

Type.—♀.

I have not seen a specimen of this species, and can give only a translation of the unfortunately incomplete original description. It is apparently closely related to *T. spectabilis*, and can from our present knowledge only be distinguished from it by the larger ocelli which place it in another genus.

Distribution.—Peru.

Athyredon atriventris (Cress.).

Ophion atriventris Cresson, Proc. Acad. Nat. Sci. Phila., p. 374, n, 4, ♀, Mexico.....1873.

Thyreodon rufithorax Cameron, Biol. Centr. Amer., Hym., I, p. 290, n. 7, ♀, pl. 12, p. 15, Panama, Bugaba, 800 to 1,500 feet.....1886.

Athyreodon thoracicus Ashmead, Proc. U. S. Nat. Mus., No. 1206, p. 87 (Vol. 23).....1900.

Tipulophion gigas Kriechbaumer, Zeits. f. Syst. Hym. Dipt., I, p. 76 .....1901.

Athyreodon thoracicus Dalla Torre, Cat. Hym., III, p. 185.....1901.

Thyreodon rufithorax Dalla Torre, Idem, p. 186.....1901.

Ophion atriventris Dalla Torre, Idem, p. 188.....1901.
Tipulophion rufithorax Schulz, Zeits. f. Syst. Hym. Dipt., III, p. 249.....1903.
Thyreodon rufithorax Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 20.....1905.
Ophion atriventris Szepligeti, Idem, p. 31, n. 90.....1905.
Macrophion ornatus Szepligeti, Idem, p. 33, n. 2, ♀, pl. 2, fig. 17..1905.
Tipulophion rufithorax Schulz, Spolia Hym., p. 97,.....1906.
Macrophion ornatus Schmiedeknecht, Opusc. Ichn., XVIII, p. 420.....1908.

Thorax fulvous; flagellum of antennæ and abdomen black; wings hyaline, with the radial and more or less of the median and cubital cells dark fuliginous; metathorax coarsely reticulate.

Length, 29–33 mm.; wing, 23-26 mm.; spread, 48-55 mm.; antennæ, 22–23 mm.

Head with vertex and flagellum of antennæ black; scape fulvo-ferruginous; ocelli large and prominent, entirely filling the space between the tops of the eyes; eyes large, emarginate; face narrow; clypeal foveæ distinct.

Thorax flavous to dark fulvous, smooth and shining except on the mesonotum and scutellum which are finely punctured; mesonotum with deep parapsidal furrows converging toward the base of the scutellum; metathorax somewhat rounded behind and very coarsely reticulated.

Wings hyaline, with radial and more or less of the cubital cells dark fuliginous, stigma lacking; nervulus postfurcal to interstitial; nervellus broken well above the middle; discocubital vein arcuate.

Legs with posterior coxæ and trochanters, and the four anterior legs except the feet and intermediate tarsi, flavous; the rest black.

Abdomen smooth and shining, black with a bluish reflection, sometimes with a slight reddish ground color showing through.

In describing this species I have examined the types of *A. thoracicus* Ashm. and *atriventris* Cress., comparing them and one other specimen with the various descriptions.

Type.—♀. No. 71, American Entomological Society.

This distinct species is easily recognized by the contrasting colors of the body, but owing to variation in the color of the thorax, and the extent of fuliginous in the wings, it has been described with several different species and confused with related forms. The thorax is normally light fulvous, but occasionally has a slight reddish tinge and is rarely ferruginous. The amount of fuliginous in the wings varies

from a condition where all of the median and most of the radial and cubital cells are of this shade, to a state where it is only present as a narrow band along the basal vein, while in the radial and cubital cells the bases or even the whole cubital cell may be hyaline. In the types of *A. atriventris* the median and radial cells are fuliginous; in the type of *Tipulophion gigas* the radial, base of the cubital and the median except a median longitudinal hyaline stripe, are fuliginous; in the type of *T. rufithorax* the fuliginous occupies the radial cell, except the base, and forms a long band along the basal vein. *T. spectabilis* is related to *atriventris*, for they agree in size and color of the body, but in the former the eyes are small and narrow, the metathorax finely striate, not coarsely reticulate and the whole apex of the wing is fuliginous.

An examination of the type of *A. thoracicus* satisfies me that it is a synonym of *A. atriventris* Cress.; the description of *Tipulophion gigas* and the descriptions and colored plates of *Macrophion ornatus* Szep. and *Thyreodon rufithorax* Cam. show that they are also synonymous. Mr. W. A. Schulz states that *Macrophion fenestratus* Szep. is the hitherto unknown male of *A. atriventris* (*T. rufithorax*), but this is evidently a mistake, for *Macrophion fenestratus* is synonymous with *Athyreodon fenestratus* Tasch.

Distribution.—This species apparently ranges from Mexico to southern Brazil. It has been reported from Orizaba, Mexico; Honduras; Costa Rica, Volcan de Chiriqui at 7,000 feet, etc.; Bugaba, Panama, 8 to 1,500 feet; Brazil, Orobo in Bahia, Theresapolis in Santa Catharina, Rio de Janeiro, Rio Grande do Sul.

Nothing is recorded of the life history, habits or hosts.

Location of specimens.—American Entomological Society, type ♀, No. 71, Mexico. Massachusetts Agricultural College, homotype, ♀, Chiriqui. U. S. National Museum, type of *thoracicus* Ashm. British Museum.* Munich State Museum,

* The type of *Thyreodon rufithorax* Cam. is *not* in the British Museum, and may have been retained by Mr. Cameron or deposited in the Vienna Museum with some of his other material.

type of *Tipulophion gigas* Kriech. Strassburg Zoological Museum, Honduras; Brazil, Orobo in Bahia, Theresapolis in Santa Catharina.

Athyreodon fulvescens (Cress.).

Thyreodon fulvescens Cresson, Proc. Ent. Soc. Phila., IV, p. 46, ♂, Cuba .....1865.
" " Ashmead, Proc. Ent. Soc. Lond., p. 354.....1900.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 9.....1905.

Fulvous; antennæ fulvous; ocelli large; wings hyaline to fulvous with the apex fuscous, basal half of second abdominal segment black above.

Length, 25–27 mm.; wing, 17–18 mm.; spread, 36–39 mm.; antennæ, 17 mm.

Reddish-brown coated with yellowish pubescence; face, eyes, back of head and mandibles, except the tips, yellow; vertex and ocelli flavous; ocelli large, eyes slightly emarginate, tinged with ferruginous; antennæ two-thirds the length of the body; clypeal foveæ deep, clypeus with a distinct point, surmounted by a median prominence; thorax smooth and shining or finely and indistinctly punctured; mesonotum with deep parapsidal furrows converging toward the scutellum; pleuræ smooth and shining; scutellum tinged with yellow; metathorax opaque, flat behind, and indistinctly rugose; more coarsely reticulate on the sides; median furrow shallow.

Wings hyaline to bright flavous, with the apex fuscous; stigma lacking; discocubital vein arcuate, nervulus interstitial, nervellus broken above the middle; first recurrent vein one-half the length of the second; legs fulvous, tibiæ and tarsi slightly paler; abdomen elongate, strongly compressed, smooth and shining; the basal half of the second segment black above; anal valves long (2 mm.), slender and obtusely pointed.

In describing this species I have examined the type ♂.

Type.—♂. No. 69, American Entomological Society.

Athyreodon armstrongi n. sp.

Fulvo-ferruginous; dorsum of second abdominal segment black; wings hyaline, with most of the radial cell and a band along the basal vein black.

Length, 37 mm.; wing, 26 mm., spread, 56 mm.; antennæ, 25 mm.

Fulvo-ferruginous, closely and densely punctured; vertex of the general color; ocelli large, somewhat separated, but almost filling the

space between the tops of the eyes, a median ridge running from the anterior to or slightly below the deep, bordered antennal fossæ; eyes emarginate, large, reaching almost to the base of the mandibles; clypeus bluntly pointed, clypeal foveæ deep; mandibles broad, stout, punctured.

Thorax shining, fulvo-ferruginous; thoracic sutures and parapsidal furrows distinct, more or less crenulated; metathorax very coarsely and irregularly reticulate throughout, with small but distinct protuberances at the anterior margin, one in the middle and one on each side.

Wings hyaline, the anterior with the apical two-thirds of the radial cell, a spot in the upper basal third of the cubital cell and a stripe along the basal vein, black; the median cell is slightly infuscated, suggesting that, in some specimens, it may be black; nervulus interstitial, nervellus broken far above the middle, near the cubital vein.

Legs smooth and shining, dark fulvous, sometimes more or less fuscous. Abdomen ferruginous, not very strongly compressed; apex of the first segment and dorsum of the second black, the rest slightly tinged with fuscous.

Described from one male specimen.

Type.—♂. U. S. National Museum.

I have named this species in honor of Mr. A. H. Armstrong, a worker on Hymenoptera whose untimely death has undoubtedly prevented valuable contributions to our knowledge of this group.

Distribution.—San Francisco Mountains, Santo Domingo, West Indies, September.

Genus **THYREODON** Br.

Thyreodon Brullé, Hist. Nat. Ins. Hym., IV, p. 150, November..1846.
" Cresson, Proc. Acad. Nat. Sci., Phila., p. 375 (January, 1873) .....1874.
" Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 425....1876.
" Provancher, Faun. Ent. Can., Hym., IV, p. 352.....1883.
" Cameron, Biol. Centr. Amer., Hym., I, p. 288.....1886.
" Ashmead, Smith's Ins. N. J., p. 580.....1900.
" " Trans. Ent. Soc. Lond., pp. 270, 354.....1900.
" " Proc. U. S. Nat. Mus., No. 1206, pp. 87, 188 (Vol. XXIII, 1901). Classification of Ichneumon Flies..... ..1900.
" Dalla Torre, Cat. Hym., III, p. 185.....1901.
Tipulophion Kriechbaumer, Zeitschr. Hym. Dipt., I, p. 75.....1901.
Aglaophion Cameron, Journ. Straits Branch Soc., p. 131.....1903.
Thyreodon Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25.....1905.
" Schmiedeknecht, Opusc. Ichn., XVIII, p. 1418.....1908.

Ocelli small, separated from the tops of the eyes by about twice their diameter; wings without stigma; discocubital vein arcuate, not appendiculate; nervellus usually broken well above the middle; nervulus usually postfurcal to interstitial; claws pectinate; abdomen compressed.

Generic type.—*T. cyaneus* Br.

The species of this genus are large, often bright colored insects, usually more or less extensively marked with black on both body and wings. They are closely related to members of the Genus *Athyreodon*, but may be recognized by their small ocelli. The Ophions may be readily distinguished by the presence of a stigma, discocubital vein usually angularly broken and appendiculate, nervellus usually broken below the middle and the wings usually hyaline, while the ocelli are usually larger. A few species, however—*O. costale*, *bifoveolatus*, etc.—sometimes at least, have these characters as in *Thyreodon* except for the presence of a distinct stigma. These specimens are always smaller than the Thyreodons, and the wings are not distinctly marked with black.

The Genus *Thyreodon* was proposed by Brullé in 1846 for three strictly American species—*T. cyaneus*, *morio* and *marginipennis*. The generic type was not designated and, so far as I can learn, has not yet been. I therefore designate *T. cyaneus* Br. as the generic type, in accordance with the International Code of Nomenclature, Recommendations, Art. 30, Sect. N, as revised by the Seventh Congress; by which preference is given to the best described, best known, etc. *T. cyaneus* was the first described—by Brullé, was well known at the time and a good colored plate was given. Taschenberg mentions the Genus *Thyreodon* in 1876, but considers it synonymous with the Genus *Ophion*. All later writers have, however, considered it valid.

Distribution.—This genus includes about twenty species and subspecies of which all but two, one from Japan and one from Borneo, are American. The American species are with a few exceptions tropical, but *T. morio* ranges as far north as Quebec and Stonewall, Canada, and *T. marginipennis* comes from Uruguay and Argentina. *T. morio* and *laticinctus*

are perhaps the most widely distributed, the former ranging from southern Canada to Central America, and the latter apparently from Central Mexico to Peru.

Variation.—Members of this genus show some variation in color, especially in the amount of black. This is well brought out in *T. morio* and its subspecies *transitionalis* where the head and legs are sometimes more or less flavous or tinged with ferruginous. This variation is somewhat similar to that seen in *A. atriventris*, but the limits are not yet known, and *T. snowi* may prove to be a continuation of this. The violet-blue reflection seen in *T. cyaneus* and *T. grandis* may also prove to be simply variation, but breeding experiments are needed to settle these questions.

Economic importance.—The value of the members of this genus as parasites can not be estimated, for most of them are tropical and their hosts are unknown. So far as known, however, they are parasitic upon Sphingidæ.

Life history and habits.—Little is known of the life history or habits of the members of this genus, but that of *T. morio* is probably typical, and this, so far as known, is given under that species.

Table of Species.

1. Wings *entirely* black, with or without cyaneous reflection.....2.
   Wings *not entirely* black, with or without cyaneous reflection ...13.
2. Body *entirely* black, with or without cyaneous reflection.....3.
   Body *not entirely* black, with or without cyaneous reflection.....9.
3. Antennæ *entirely* black .....4.
   Antennæ *not entirely* black.....6.
4. Body and wings *with* a distinct cyaneous reflection.....5.
   Body *without* a distinct cyaneous reflection.....**niger** Cress.
5. Face and thorax *with* dense pubescence...**nigro-cæruleus** Cam.
   Face and thorax *without* dense pubescence.....**cyaneus** Br.
6. Antennæ yellowish-white, with base and apex black.
   morosus Sm.
   Antennæ not yellowish-white.....7.
7. Antennæ black, flavous below.....**niger** Cress.
   Antennæ flavous or orange flavous (reddish), base and apex sometimes black.....8.
8. Body and wings *with* distinct cyaneous reflection..**grandis** Cress.
   Body and wings *without* distinct cyaneous reflection.....21.
9. Abdomen fulvous, slightly marked with black.....**affinis** Cress.
   Abdomen *not* fulvous.....10.

10. Abdomen black, with median transverse band of some other color .....11.
Abdomen more or less black, *without* median transverse band of some other color.....12.
11. Abdomen with median transverse band of lemon-yellow.
laticinctus Cress.
Abdomen with median transverse band of ferruginous.
zonatus Szep.
12. Thorax and abdomen entirely black.....**morio** Fabr.
Thorax and first abdominal segment ferruginous.
ferrugineus n. sp.
13. Abdomen flavous or flavo-ferruginous, marked with black.....14.
Abdomen black or mostly black.....15.
14. Metathorax very finely reticulate.....**ornatipennis** Cress.
Metathorax coarsely reticulate.....**elegans** Cress.
15. Thorax partly or entirely fulvous to ferruginous .....16.
Thorax entirely black.....18.
16. Flagellum of antennæ *black*.....17.
Flagellum of antennæ *fulvous*.....**snowi** Vier.
17. Wings fulvo-hyaline, apex black.....**spectabilis** Perty.
Wings hyaline with radial, submarginal and part of the second apical cells black .....**grenadensis** Ashm.
18. Antennæ with flagellum black.....19.
Antennæ with flagellum fulvous or orange-fulvous.....11.
19. Wings black, with a purplish reflection and a hyaline spot in the discocubital and discoidal cells.....**maculipennis** Cress.
Wings entirely flavo- or fulvo-ferruginous.....20.
20. Face strongly rugose.....**marginipennis** Br.
Face punctate, not rugose.....**flammipennis** Ashm.
21. Abdomen black, with median transverse band of ferruginous.
fernaldi n. sp.
22. Face and legs more or less fulvous...**morio transversalis** Vier.
Face and legs shining black.....23.
23. Antennæ orange-fulvous, mesopleuræ punctured....**morio** Fabr.
Antennæ red, mesopleuræ not punctured....**erythrocerus** Cam.

Thyreodon niger Cress.

Thyreodon niger Cresson, Proc. Acad. Nat. Sci. Phila., p. 375, n. 1, ♀♂.....1873.
" " Cameron, Biol. Centr. Amer., Hym., I, p. 288, pl. 12, fig. 12.....1886.
" " Dalla Torre, Cat. Hym., III, p. 186.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 17.....1905.

Black; wings with a cyaneous reflection; antennæ black.

Length, 25–35 mm.; wing, 15–26 mm.; spread, 32–54 mm.; antennæ, 12–23 mm.

Black, with very fine short sparse pubescence; head and thorax densely punctured; head slightly narrowed behind the eyes, closely and deeply punctured; ocelli small, distant from the top of the eyes; vertex more or less distinctly reticulate; eyes large, emarginate; antennæ black, sometimes tinged with flavous beneath or the apex of the segments slightly reddish, with a more or less distinct ridge extending from the anterior ocellus down between the bases of the antennæ as in *morio;* clypeal foveæ deep, mandibles broad and stout. Thorax entirely black, densely punctured except on the mesopleuræ; thoracic sutures distinct, often crenulate; mesonotum opaque, with deep crenulated parapsidal furrows; mesopleuræ smooth and shining except on the edges, where it is sparsely punctured; metathorax opaque, flat behind, finely rugose.

Wings black with steel-blue reflection; stigma lacking; discocubital vein arcuate; nervulus interstitial; nervellus broken well above the middle; legs black, claws pectinate; abdomen black, smooth and shining, or at the most very finely punctured, with fine short scanty pubescence, in one specimen the third segment is slightly tinged with red, ovipositor red.

Redescribed from the types and three specimens compared with the original description.

Types.— ♀ and ♂. No. 65, American Entomological Society.

This species is related to *T. morio*, but may be readily recognized by the steel-blue wings and entirely black antennæ.

It is more closely related to *T. cyaneus* and may prove to be synonymous, but the absence of purplish reflection seems fairly constant.

Distribution.—Mexico; Guatemala.

The exact range of this species is not yet well known, but it seems to range through Mexico and Central America. It has been reported from Cordova, etc., Mexico; and Cubilguitz in Vera Paz, Guatemala, and I have seen specimens from Alta Mira, Tamaulipas, and Cuernavaca, Mexico.

Nothing is known of the life history, habits, or hosts; three specimens before me were taken June 26 and July 4.

Location of specimens.—American Entomological Society,

♀ and ♂, types No. 65, Mexico. U. S. National Museum, ♀, Cuernavaca, Mexico. Massachusetts Agricultural College, ♀ and ♂, homotypes, Alta Mira, Mexico, VI, 26.

Thyreodon nigro-cæruleus Cam.

Thyreodon nigro-cæruleus Cameron, Journ. Royal Agr and Commer. Soc., British Guiana, I, p. 180..1911.

"Length, 27 mm.

"Black, tinged with blue on the pleuræ and metanotum; wings uniformly fuscous-violaceous, the nervures and stigma black. Face covered with pale, the thorax more densely with longer black pubescence, which is longest on the scutellum. Head and thorax closely punctured, the center of the scutellum smoother than the sides. The sides of the metanotum finely, sparsely punctured, the center raised, irregularly longitudinally reticulated; the top of the slope finely, obliquely striated, the striæ interlacing; the sides below are more strongly obliquely striated, smooth on the inner side; the central furrow is strongly, not very closely, transversely striated. Metapleuræ closely finely obliquely striated. Front broadly raised between the antennæ and ocelli, the sides depressed, the depression narrowed above, the bottom, except at the top, finely, closely striated. Female.

"Apex of clypeus transverse, its sides broadly rounded. Sides of scutellum keeled to shortly beyond the middle."

This is evidently closely related to *T. cyaneus* Br., and may be a synonym for it is based on only one specimen, and the long pubescence on the face and scutellum may be abnormal.

Distribution.—British Guiana.

Location of specimens.—Georgetown Museum, Brit. Guiana.

Thyreodon cyaneus Br.

Ophion morio Spinola, Ann. Ent. Soc. Fr., IX, p. 168, n. 22, ♀ (*non* Fabr.).....1840.

Thyreodon cyaneus Brullé, Hist. Nat. Ins. Hym., IV, p. 151, n. 1, ♀ ♂, pl. 42, fig. 3.....1846.

Ophion cyaneus Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 425, n. 1.....1875.

Thyreodon cyaneus Dalla Torre, Cat. Hym., III, p. 185 .....1901.

" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 4.....1905.

" *intermedius* Szepligeti, Ann. Hist. Nat. Mus. Nat. Hung., IV, Part 1, p. 133, Obidos, Brazil.....1906.

Cyaneous, antennæ black, wings with brilliant blue reflection.

Length, 27–34 mm.; wing, 16–18 mm.; spread, 34–40 mm.; antennæ, 14–20 mm.

Cyaneous; head opaque; ocelli small, distant from tops of eyes; eyes large, emarginate; antennæ black, much shorter than body; clypeal foveæ distinct; thorax and abdomen cyaneous; thoracic sutures deep, crenulated; mesonotum opaque, slightly pubescent and punctate, with two more of less pronounced tubercles on the anterior edge; parapsidal furrows deep and crenulated, often with one or more parallel carinæ on the median lobe; metapleuræ smooth and shining or punctate around the edge; metathorax finely rugose-striate with a distinct median furrow.

Wings black with bright purplish-blue reflection; stigma lacking; discocubital nervure arcuate; nervulus interstitial to antefurcal; nervellus broken well above the middle; legs with claws pectinate; abdomen smooth and shining with short sparse pubescence; stigmata quite pronounced; ovipositor reddish.

In describing this species I have compared ♀ and ♂ specimens with the original description.

Type.—♀ and ♂. Location unknown.

Distribution.—Brazil; Dutch Guiana.

This species was described by Brullé from specimens taken at Cayenne, Caternaut; Brazil (Capit des Mines); and I have before me specimens from Surinam, Dutch Guiana.

Nothing is known of the life history, habits or hosts.

Location of specimens.—British Museum. Massachusetts Agricultural College, ♀ and ♂, Surinam, Dutch Guiana.

Thyreodon morosus Sm.

Thyreodon morosus Smith, Descr., New Spec. Hym., p. 230, n. 1, ♀.....1879.
" " Cameron, Biol. Centr. Amer., Hym., I, p. 289, n. 3.....1886.
" " Dalla Torre, Cat. Hym., III, p. 186.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 16.....1905.
" *pulchricornis* Szepligeti, Ann. Hist. Natur. Mus. Nat. Hung., IV, p. 133, Marcapata, Peru.....1906.

Black; wings dark brown with violet-purple reflection; antennæ white to yellowish-white with base and apex black.

Length, 23–33 mm.; wing, 16–24 mm.; spread, 34–51 mm.; antennæ, 15–20 mm.

Black; vertex and frons more or less reticulate, with a minute median

tubercle below the bases of the antennæ and two diverging carinæ running back from it towards the ocelli; ocelli small, distant from the tops of the eyes; eyes large, emarginate; antennæ white or yellowish-white with the base and apex black; face closely punctured, clypeal foveæ deep.

Thorax opaque, densely punctured to granulose, except the mesopleuræ, which are shining, very finely and sparsely punctured; mesonotum with deep, crenulated parapsidal furrows uniting behind; metathorax finely rugose-striate, with a distinct median furrow.

Wings dark brown to black with a brilliant violet-purple reflection; discocubital vein arcuate; nervulus interstitial; nervellus broken well above the middle; legs black, claws pectinate; abdomen smooth and shining, with an obscure violet reflection.

In describing this species I have compared one ♀ and two ♂ specimens with the original description.

Type.—♀. British Museum.

This species somewhat resembles *T. morio* and *grandis*, but is much more slender and easily recognized by the whitish antennæ.

Distribution.—This species ranges from Costa Rica to southern Brazil; it has been reported from Cache, Costa Rica. Szepligeti's specimen came from Marcapata, Peru, and I have before me specimens from San Carlos, Costa Rica, and Rio Grande do Sul, Brazil

Location of specimens.—British Museum, type ♀, Costa Rica. U. S. National Museum, ♂, San Carlos, Costa Rica. Massachusetts Agricultural College, ♀ and ♂, Rio Grande do Sul, Brazil. Hungarian Natural History Museum, ♀ and ♂ types of *T. pulchricornis* Szep., Marcapata, Peru.

Thyreodon grandis Cress.

Thyreodon grandis Cresson, Proc. Ent. Soc. Phila., IV, p. 45, Cuba ..... 1865.
" " Cameron, Biol. Centr. Amer., Hym., I, p. 289..1886.
" " Ashmead, Proc. Ent. Soc. Lond., p. 354.....1900.
" " Dalla Torre, Cat. Hym., III, p. 185 .....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 185, n. 10 .....1905.

Black; antennæ fulvous, wings deep violaceous.

Length, 22–34 mm.; wing, 19–23 mm.; spread, 42–48 mm.; antennæ, 18–22 mm.

Head entirely black; face finely and densely punctured; ocelli small; eyes black, flecked with fulvo-ferruginous, slightly emarginate; antennæ fulvous, darker at apex; basal joint sometimes black, two-thirds the length of the body; clypeal foveæ deep.

Thorax finely and densely punctured; middle of mesonotum and mesopleuræ shining, anterior margin of the mesonotum with a small protuberance on each side; parapsidal furrows converging towards the scutellum and confluent slightly beyond the middle, forming a Y-shaped groove, each containing a more or less distinct carina; scutellum convex, densely punctured, deeply excavated in front and with a well-defined carina on each side; metathorax opaque-black, finely pubescent, flat, only slightly excavated behind, with a shallow median furrow, and sometimes quite strongly contracted at the base; finely and longitudinally striated behind, the sides more coarsely; in one specimen the metathorax is finely reticulated all over.

Wings uniformly dark fuscous, with brilliant violaceous reflection; in some specimens the apical margins lack this reflection; nervulus interstial or nearly so; nervellus broken well above the middle; legs and abdomen smooth, shining black.

Abdomen impunctate, rather broad and compressed; basal segment the longest and swollen at the apex, the second segment one-fourth shorter, gradually broader towards the tip, with a shallow longitudinal furrow on the basal half of each side; third segment shorter than the second and slightly longer than broad, the remaining segments broader than long.

In describing this species I have compared the cotypes and one female specimen with the original description.

Cotypes—Two ♀ and one ♂. American Entomological Society.

This distinct species is easily recognized by the brilliant reflection of body and wings. Mr. Cresson states that "in the male the wings are not so dark, the apical margins being subhyaline, and the violaceous reflection not so deep." I find, however, that this condition appears frequently in the female, and is apparently a minor variation common to both sexes.

T. erythrocerus Cameron is possibly synonymous with this species, but as I have not seen the type I am unable to say definitely. *T. morio*, *morosus*, *niger* and *cyaneus* are also related, but may be readily separated; *morio* by its dull black body and wings, and stouter body; *morosus* by its yellowish white antennæ and more slender body; *cyaneus* and *niger* by their black antennæ.

Distribution.—Santiago de Cuba, Cuba.

Location of specimens.—American Entomological Society, two ♀ and one ♂ cotypes, No. 72, Cuba. American Museum of Natural History, ♀, homotype, Santiago de Cuba, Cuba. U. S. National Museum, Cuba. British Museum, ♀, type of *T. erythrocerus* Cam., Valladolid in Yucatan.

Thyreodon affinis Cress.

Thyreodon affinis Cresson, Proc. Ent. Soc. Phila., IV, p. 46.....1865.
" " Ashmead, Trans. Ent. Soc. Lond., p. 354.....1900.
" " Dalla Torre, Cat. Hym., III, p. 185 .....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 3.....1905.

Fulvous or honey-yellow; tip of antennæ and base of second abdominal segment blackish; wings fuscous, with a violaceous reflection.

Length, 42 mm.; wing, 16 mm.; spread, 36 mm.

Fulvous or honey-yellow, shining, clothed with a very short, yellowish pubescence, more obvious when viewed laterally; eyes paler, antennæ fulvous, the apical joints brown varying to black, two-thirds the length of the body; mandibles tipped with blackish.

Thorax indistinctly punctured; the mesonotum with parapsidal furrows broad and deep, with a subobsolete elevated line down the middle of each groove; mesopleuræ polished; scutellum convex, deeply excavated in front, with a carina on each side acutely developed; metathorax abruptly sloped behind, with a broad shallow median furrow becoming deeper towards the insertion of the abdomen where the surface is longitudinally striated, the remainder of the surface indistinctly sculptured; wings dark fuscous, with a violaceous reflection, more obscure on the apical margin; nervures blackish; legs of the color of the body.

Abdomen elongate, falcate, the apical segments compressed but not very broad, the basal half of the second segment above black; anal processes broad, obliquely pointed at the tips, which are acute.

I have not seen the type of this species, and can only give the original description, slightly modified for simplicity.

Type.—♂. Caja No. 93, Instituto de Segunda Enseñanza de la Habana, Cuba.*

Distribution.—Cuba.

* Mr. Wm. T. Horn writes that at the time he saw this type on May 22, 1909, it appeared to be in a good state of preservation, in a small cigar box with a glass face—Caja No. 93. This with the rest of the Gundlach collection is now in the Instituto de Segunda Enseñanza de la Habana, located on Obispo Street (in the first block above the palace), Dr. Cañizares director.

Thyreodon laticinctus Cress.

Thyreodon laticinctus Cresson, Proc. Acad. Nat. Sci. Phila., p. 376, n. 3, ♀, Mexico.....1873.
" *principalis* F. Smith, Descr. New Spec. Hym., p. 230, n. 2, ♀, Costa Rica, C. M.....1879.
" *laticinctus* Cameron, Biol. Centr. Amer., Hym., I, p. 289, pl. 12, fig. 14.....1886.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" *principalis* Dalla Torre, Idem, p. 186.....1901.
" *laticinctus* Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 12.....1905.
" *principalis* Szepligeti, Idem, p. 25, n. 19.....1905.
" *laticinctus* Schulz, Spolia Hym., p. 97, n. 185.....1906.

Black; third and fourth abdominal segments lemon-yellow; wings with a brilliant purplish reflection.

Length, 24–33 mm.; wing, 18–24 mm.; spread, 38–48 mm.; antennæ, 15–20 mm.

Head, thorax and legs coated with fine black pubescence; ocelli small, distant from the tops of the eyes, varying in color from flavous or flavous with an outer band of black, to entirely black; eyes large, slightly emarginate, face deeply punctured.

Thorax dull black, except the mesopleuræ which are polished; mesonotum slightly shining, parapsidal furrows shallow, broad, opaque, finely reticulate to rugose, ending in two small, sometimes indistinct protuberances at the anterior border; metathorax clothed with dense, short pubescence, flat or only shallowly excavated behind with a distinct median furrow.

Wings black with brilliant purplish reflection; nervulus interstitial; nervellus broken somewhat above the middle.

Legs black, sparsely pubescent and shining.

Abdomen polished, black, except the third and the greater part of the fourth segments which are lemon-yellow; basal segment slightly dilated at the apex; genital valves of male abruptly sharply pointed.

In describing this species I have compared the type and four specimens with the original description.

Type.—♀. No. 73, Mexico, American Entomological Society.

This distinct species may be readily recognized by the lemon-yellow band on the abdomen. There is no reason to doubt that *T. principalis* Smith is synonymous. *T. zonatus* Szep. is also closely related, but in that species the abdominal band is ferruginous (gelbroth) not lemon-yellow. This may prove to be a subspecies of *laticinctus*, for Cameron's

plate of the latter shows the plate on the abdomen colored ferruginous, and the distribution corresponds.

Distribution.—This species ranges from Orizaba, Mexico, at 19° to below the equator at Chauchamayo, Peru. It has been taken at Chiriqui and Orizaba, Mexico; in Guatemala, at Zapote and Senahu; in Honduras; in Panama, at Chiriqui; in Colombia at Canauche, in the State of Cundinamarca, etc.; in Peru at Chauchamayo and in Costa Rica.

Location of specimens.—American Entomological Society, ♀ type, No. 7, Mexico, end of abdomen gone. U. S. National Museum, two ♀'s, Chauchamayo, Peru; Mexico. British Museum, ♀ type of *T. principalis* Sm. and specimens. Massachusetts Agricultural College, ♀ and ♂, homotypes, Colombia; Chiriqui, Panama.

Thyreodon zonatus Szep.

Thyreodon zonatus Szepligeti, Ann. Hist. Natur. Mus. Nat. Hung., IV, p. 134 .....1906.

Black; wings brown; the third and fourth abdominal segments ferruginous.

Length, 35 mm.

Black; head smooth, not enlarged behind the eyes; face, frons and vertex rugose; antennal fossæ not bordered; mesopleuræ smooth; metathorax rugose behind, sides coarsely rugose, median furrow shallow, wings brown; nervulus interstitial; nervellus broken above the middle; abdomen with the third and fourth segments ferruginous (gelbroth), the second segment shorter than the first.

I have not seen a specimen of this species, and can only give a free translation of the original description somewhat rearranged.

Types.—♀ and ♂. Hungarian National Museum.

This species is closely related to *T. laticinctus* and may prove to be synonymous, but Szepligeti distinguishes it by "the mesonotum in the latter—*laticinctus*—being armed in front with two horny protuberances, while the fourth abdominal segment is not entirely ferruginous (gelbroth) and the scutellum is bordered at the sides." The protuberances on the mesonotum of *laticinctus* are quite inconstant, but the color of the abdominal band is lemon-yellow, not ferrugin-

ous. However, since Cameron's colored plate of *laticinctus* shows the third and fourth abdominal segments ferruginous this variation may be fixed, and I therefore preserve this species. The difference in color may possibly be due to the specimen having been placed in a wet cyanide jar.

Distribution.—Juntas, Bolivia.

Thyreodon morio (Fabr.).

Plate III, fig. 21.

Ichneumon morio Fabricius, Spec. Ins., I, p. 436, n. 100.....1781.
" " " Mant. Ins., I, p. 269, n. 118.....1787.
" " Gmelin, Linné. Syst. Nat., ed. 13, I, p. 2709, n. 182.....1790.
" " Olivier, Ency. Meth. Ins., VII, p. 196, n. 161.....1792.
" " Fabricius, Ent. Syst., II, p. 180, n. 194.....1793.
Ophion morio Fabricius, Suppl. Ent. Syst., p. 237, n. 8.....1798.
" " " Syst. Piez., p. 132, n. 9.....1804.
" " Olivier, Ency. Meth. Ins., VIII, p. 511, n. 14.....1811.
" *atricolor* Olivier, Idem, p. 511, n. 15.....1811.
Ichneumon morio Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 272.....1822.
" " Thunberg, Mem. Acad. Sci. St. Petersbourg, IX, p. 341.....1824.
Thyreodon morio Brullé, Hist. Nat. Ins. Hym., IV, p. 152, n. 2, ♀.....1846.
" " Norton, Proc. Ent. Soc. Phila., I, p. 359, n. 7..1863.
Ophion morio Walsh, Amer. Ent., I, p. 7.....1868.
Thyreodon morio Cresson, Trans. Amer. Ent. Soc., IV, p. 170.....1872.
Ophion morio Taschenberg, Zeitschr. f. d. Ges. Nat., 46, p. 425, n. 2.....1875.
Thyreodon morio Provancher, Nat. Can., XI, p. 119.....1879.
" " " Faun. Ent. Can., Hym., p. 352.....1883.
" " Dimmock, Psyche, IV, p. 282.....1884.
" " Cresson, Syn. Hym. of N. A., p. 200.....1887.
" " Ashmead, Hym. of Colo., Bull. Colo. Biol. Assn., p. 43.....1890.
" " Packard, Fifth Rept. U. S. Ent. Comm., p. 489..1890
" " Harringion, Ann. Rept. Ent. Soc. Ont., p. 67 ..1890.
" " Riley, Ins. Life, III, p. 155, host.....1891.
" " Dimmock, Proc. Ent. Soc. Wash., D. C., IV, pp. 149–153, host.....1898.
" " Dimmock, Idem, p. 156 (*Encyrtus thyreodontis* Ashm., a parasite).....1898.
" " Bridwell, Trans. Kans. Acad. Sci., XVI, p. 204..1898.

Thyreodon morio Ashmead, Smith's Cat. Ins. N. J., p. 580.....1900.
" " Dalla Torre, Cat. Hym., III, p. 186.....1901.
" " Eliot and Soule, Caterpillars and their Moths, p. 57.....1902.
" " Howard, Insect Book, pl. 10, fig. 15.....1904.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25....1905.
" " Viereck, Trans. Kans. Acad. Sci., p. 313.....1907.
" " Fletcher and Gibson, 39th Rept. Ent. Soc. Ont., p. 112, Stonewall, Manitoba, July.....1909.
" " Morley, The Entomologist, XLII, p. 136, n. 100, June.....1909.

Black; face and legs sometimes more or less flavous or tinged with ferruginous; antennæ orange-fulvous, the base and apex sometimes fuscous.

Length, 25–35 mm.; wing, 16–25 mm.; spread, 34–53 mm.; antennæ, 16–23 mm.

Black; face, mouth parts and legs sometimes more or less flavous or tinged with ferruginous; head and thorax densely and finely punctured and clothed with fine, short, pubescence; vertex somewhat rugose, with ocelli small, distinct, fully twice their diameter from the tops of the eyes, a median keel running from the anterior to or below the base of the antennæ; eyes large to medium, slightly emarginate; antennæ orange-fulvous with the scape and apex sometimes fuscous or black; clypeus pointed in front; clypeal foveæ deep.

Thorax black, densely punctured and clothed with short black pubescence; thoracic sutures distinct, often crenulated; mesonotum with parapsidal furrows more or less distinct; pleuræ and pectus shining; wings fuliginous; nervulus postfurcal to interstitial; nervellus broken well above the middle.

Legs normally black, sometimes more or less flavous or tinged with ferruginous; claws pectinate; abdomen shining black, sometimes with a little dark ferruginous ground color showing through.

In describing this species I have examined over 100 specimens from all parts of the United States.

Type.—Location unknown.

This common species is easily recognized by its orange-fulvous antennæ and usually entirely black body. The head and legs are sometimes more or less flavous or fulvous, and in the subspecies *transitionalis* a clear spot appears in the wings, but just how constant this is can not be stated. *T. snowi* Vier. is also closely related and may prove to be only a subspecies continuing the variation begun in *T. morio transitionalis*, but as I have not seen the type or a specimen of this

species I am unable to decide this. Though not mentioned by Cameron there are two specimens of this species which bore the MSS. label "*personatus* Cameron" in the Biologia material at the British Museum.

Distribution.—This species ranges from southern Canada into Mexico and Central America. It has been taken in Stonewall, Manitoba, and Quebec, Canada; Maine, Pennsylvania, Florida, Texas, Ohio, Arizona, Kansas and Colorado, besides many other places within these limits. Morley states that it is quite common in Central America.

Life history and habits.—This, the most common member of the genus in the United States, will be found in almost any large collection. It is diurnal, and frequently seen in July and August along wooded roads, darting every now and then into the underbrush or flying among the blossoms by the roadside. In Massachusetts it appears about the twentieth of June, but does not become abundant until the second week in July, when it continues so till the last of August. It has been taken as early as March 27 and as late as October, but it appears throughout its range to be most abundant in July and August. The eggs are laid as usual, and the pupæ formed in the earth outside of the host. Mrs. A. K. Dimmock states (in litt.) that "in one or two cases, where the host larva was left without earth, the *Thyreodon* larva came out of it for pupation. *T. morio* always hibernates as a pupa, and all of its pupations which have been observed occurred in September." The cocoon is compressed oval, 19–20 mm. long and 10 mm. broad, composed of black silk compactly glued together.

Economic importance.—The abundance of this parasite indicates that it is quite beneficial, especially as it is always fatal to its host, but thus far only two hosts have been reported. There is in the U. S. National Museum a specimen bred from *Lapara* (*Sphinx*) *coniferarum*, and Mrs. A. K. Dimmock reports a case at Cambridge, Mass., where out of thirty larvæ of *Paonias* (*Smerinthus*) *excæcatus* Abb. and Sm. eleven were killed by this parasite, and another at Canobie Lake, N. H., where four out of 26 cocoons of the same insect were paratized

by *T. morio*. One cocoon of *T. morio*, however, produced a large number of minute Hymenoptera, secondary parasites, which Dr. Ashmead determined as a new species of chalcid and has described* as *Encyrtus thyreodontis*. The exact range and effectiveness of this hyperparasite are unknown, but "from this one cocoon 170 specimens were preserved and many lost." The larvæ of *T. morio* are occasionally at least attacked by fungi, for Mrs. A. K. Dimmock states that "one of the larvæ taken at Canobie Lake, N. H., after coming out of its host died of fungus of apparently the same species which attacks its host larva."

In numerous rearings of two related sphingids, *Smerinthus jamaicensis* Dr. (*S. geminatus* Say) and *Paonias myops*, no parasitism by *T. morio* was observed.

The U. S. National Museum collection contains specimens of this species from Nyack and Long Island, N. Y.; Mass.; Conn.; Washington, D. C.; Mo., and Kansas.

Thyreodon ferrugineus n. sp.

Head flavo-ferruginous; thorax and first abdominal segment ferruginous, the rest of the abdomen shining black; wings black, with a slight purplish reflection except at the apical margin.

Length, 40 mm.; wing, 22 mm.; spread, 47 mm.

Head ferruginous, more or less tinged with flavous; antennæ with scape ferruginous (remainder missing); ocelli small, distant from the tops of the eyes; eyes medium sized, at a little distance from the base of the mandibles, emarginate; face between the eyes and bases of the antennæ mostly flavous; clypeus pointed in front; clypeal foveæ shallow, more or less elongate; mandibles stout, bidentate, tipped with black.

Thorax and legs ferruginous, dorsum of thorax and the posterior legs darker; mesonotum with parapsidal furrows distinct, crenulated, converging and uniting at or before the posterior margin.

Pleuræ and pectus smooth and shining; metathorax with sides smooth and shining, behind finely rugose, its posterior two-thirds with a wide median furrow in which is an indistinct median carina; the outer border of the metathorax—behind—slightly raised, forming a depression between the median furrow and this elevation.

Wings black with a purplish reflection, except at the apex; stigma lacking; nervulus interstitial; nervellus broken above the middle;

* Proceedings of the Entomological Society of Washington, Vol. IV, page 156, No. 7, ♀.

legs ferruginous with the tibiæ darker, and the tarsi light, almost flavous.

Abdomen with the basal segment, a lateral longitudinal stripe on the second and a dorsal spot on the two apical segments ferruginous, the rest shining black, with a slight bluish reflection.

Described from one male specimen.

Type.—American Entomological Society.

This species is closely related to *T. spectabilis*, but may be readily recognized by the entirely black wings, with purplish reflection, and the ferruginous on the thorax, legs and part of the abdomen. A series of specimens may show that the tibiæ are normally black.

Distribution.—Guadalajara (Jal.), Mexico, August 27.

Thyreodon ornatipennis Cress.

Thyreodon ornatipennis Cresson, Proc. Acad. Sci. Phila., p. 376, n. 4, ♀ ....1873.
" " Cameron, Biol. Centr. Amer., Hym., I, p. 290.....1886.
" " Dalla Torre, Cat. Hym., III, p. 186.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 18.....1905.

Brownish ferruginous; antennæ fulvous; wings fuliginous with a fulvo-hyaline spot extending across the middle and sometimes occupying most of the base; dorsum of second abdominal segment more or less black.

Length, 30–40 mm.; wing, 22–25 mm.; spread, 47–54 mm.; antennæ, 20–22 mm.

Brownish ferruginous, clothed with fine short pubescence; head fulvo-ferruginous; antennæ fulvous, sometimes darker at the apex; ocelli small, distant from the tops of the eyes; eyes medium sized, broad, emarginate; face finely punctured; clypeal foveæ deep; mandibles stout.

Thorax brownish ferruginous, densely and finely punctured and pubescent; mesonotum with parapsidal furrows deep, uniting at or before its posterior border; mesopleuræ and pectus shining, sometimes with a small black spot below the base of the wings; thoracic sutures distinct, crenulated; metathorax large, globular, very finely reticulate and with median furrow, its apex at the insertion of the abdomen deeply excavated.

Wings fuliginous, with a fulvo-hyaline stripe extending across the middle of the anterior and half-way across the posterior, sometimes occupying most of the base of both; nervulus interstitial; nervellus

broken well above the middle; legs fulvo-ferruginous; tips of tarsi sometimes black; claws pectinate; abdomen brownish ferruginous; base of the second segment black above; the segmets beyond the second sometimes fuscous; on one specimen the three apical segments blackish.

In describing this species I have examined the ♀ type and one ♀ specimen.

Type.—♀. No. 74, American Entomological Society.

This species varies somewhat in the extent of the fulvo-hyaline spot in the wings. It is related to *T. elegans*, but in that species the metathorax is coarsely reticulate and the ocelli slightly larger.

Distribution.—This species evidently ranges from southern United States into Central America. It was described from Mexico; Cameron reports it from Orizaba, Mexico, and I have before me a specimen from New Mexico.

Location of specimens.—American Entomological Society, type ♀, No. 74, Mexico; ♀ specimen, New Mexico.

Thyreodon elegans Cress.

Thyreodon elegans Cresson, Proc. Ent. Soc. Phila., IV, p. 47.....1865.
" " Ashmead, Proc. Ent. Soc. Lond., p. 354.....1900.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 5.....1905.

Fulvous; wings fulvous, with a broad apical band of fuliginous; dorsum of second abdominal segment black at the base; mesonotum with three broad black bands; abdomen margined with ferruginous above and beneath.

Length, 25 mm.; wing, 11.6 mm.; spread, 25.5 mm.; antennæ, 25 mm.

Head shining yellow, with a spot behind each antenna, the vertex and a spot in the middle of the face just below the antennæ, black; most of the occiput brown-black; antennæ scarcely half the length of the body, stout, fulvous, with the apical joints black and the scape beneath tinged with yellow.

Thorax shining, slightly pubescent, finely punctured; mesonotum with three broad black longitudinal stripes, more or less distinct, the median extending from the anterior margin almost to the scutellum, the lateral ones shorter in front but reaching the posterior margin;

(lateral?) dorsal lines indistinct, median line depressed in front and slightly carinated longitudinally, the angles in front on each side of the depression elevated to an obtuse tubercle; pectus blackish, slightly reddish in front; mesosternum with a yellow line running down each side; pleuræ polished yellow, with a broad, uneven, longitudinal line on each side bordering the posterior suture; a transverse line on each side below and the entire surface between the four anterior coxæ, black; space between the pleura and metathorax blackish, broadly yellow on each side; scutellum prominent, quadrate, yellow, densely punctured, deeply excavated in front and acutely carinated on each side, the excavation blackish; postscutellum yellow; metathorax prominent, coarsely reticulated throughout, yellow, the basal suture strongly contracted; abruptly sloped behind and with a distinct, blackish, median furrow.

Wings rather short, deep yellow-hyaline, the apical margin broadly fuliginous; nervures honey-yellow; the posterior wings with a large fuscous spot near the base.

Legs yellow, a large spot at the base of the posterior coxæ, the anterior femora beneath obscurely, the four posterior femora except the base and apex, and the extreme tips of all the tarsi, blackish.

Abdomen elongate, polished, broad and compressed toward the tip; the two basal segments honey-yellow, with the posterior half of the dorsum of the first and anterior half of the dorsum of the second black; the remaining segments honey-yellow, their sides margined with bright yellow.

I have not seen a specimen of this species, and can only give the original description with slight modifications in arrangement.

Type.—♀. Caja No. 337, Instituto de Segunda Enseñanza de la Habana.*

Mr. Cresson remarks that in this beautiful species "the antennæ and wings are much shorter than in any other species of this genus."

Distribution.—Cuba.

* Mr. Wm. T. Horne writes that when he saw this type, May 22, 1909, it appeared to be in a good state of preservation. It was in a small cigar box with a glass face—Caja No. 93. This with the rest of the Gundlach collection is now in the Instituto de Segunda Enseñanza de la Habana, Obispo Street—in the first block above the palace—Havana, Cuba, Dr. Cañizares, director.

Thyreodon snowi Vier.*

Thyreodon snowi Viereck, Trans. Kans. Acad. Sci., XIX, p. 313, ♀..1905.

Black; antennæ orange with scape brown; head, legs and margin of the mesonotum and mesopleuræ more or less brownish; wings fuscous, with a broad bare yellow area in the middle of the anterior half of the posterior pair.

Length, 25 mm.

Black; eyes and cheeks brownish; antennæ orange with the scape and pedicel brown; head somewhat broader than in *morio;* the face more even, closely and densely punctured, giving a rugulose appearance, except along the eye margins where the punctures are distinct; antennæ with 61 joints; the scape and pedicel together a little longer than the first joint of the flagellum; clypeus sparsely and deeply punctured; cheeks shining, distinctly and closely punctured.

Thorax with anterior border of the mesonotum and border of the mesopleuræ more or less brownish; mesonotum shining, distinctly and closely punctured, especially on the anterior margin, where the punctures are so close as to give a rugulose appearance; parapsidal furrows distinct, rugose, forming a V and not reaching the posterior border; scutellum closely punctured, with an acute carina; mesopleuræ closely punctured and nearly rugulose below, smooth and polished above; metathorax rugulose, the sides closely punctured behind, with a median transversely striate groove; wings fuscous, not as dark as in *morio*, with a broad bare yellow area in the middle of the anterior half of the posterior wings; neuration nearly as in *morio*, with the nervellus broken well above the middle.

Four anterior legs with their terminal trochanters, femora, tibiæ, and tarsi almost entirely, and the posterior tibiæ and tarsi brownish testaceous; middle and posterior legs with the apical joint brown.

Abdomen with petiole smooth and shining, sparsely and minutely punctured; the segments as in *morio*, clothed with inconspicuous pubescence, blackish or brownish on the dark portions, golden yellow on the pale portions.

I have not seen the type or a specimen of this species, and can only give the original description slightly rearranged.

Type.—♀. University of Kansas.

This species is closely related to *T. morio* and its subspecies *transitionalis*, and may perhaps prove to be only a subspecies, but as I have not seen the type or a specimen I give it specific rank.

Distribution.—Wallace county, Kansas, 3,000 feet, June.

* Named in honor of the late Prof. F. H. Snow.

Thyreodon spectabilis (Perty).

Ophion spectabilis Perty, Delect. Anim. Artic. Brasil, p. 131, pl. 26, fig. 10, ♀ (Lat.), Brazil.....1833.
" " Dalla Torre, Cat. Hym., III, p. 199.....1901.
" " Schulz, Zeits. f. Syst. Hym. Dipt., III, p. 250..1903.
Thyreodon spectabilis Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 21.....1905.

Head, thorax and four anterior legs flavo-fulvous; vertex, flagellum of antennæ, posterior legs and abdomen black; basal two-thirds of wings bright flavous; apex fuscous; eyes small.

Length, 31–38 mm.; wing, 20–33 mm.; spread, 43–65 mm.; antennæ, 19 mm.

Head apparently long, owing to the small size of the eyes; flagellum of antennæ black; scape fulvo-ferruginous; vertex and tips of mandibles black, head otherwise fulvous; ocelli somewhat distant from the tops of the eyes; eyes small, slightly emarginate, distant from the base of the mandibles.

Thorax fulvous, tinged with ferruginous, polished, clothed with fine yellowish pubescence, longer and more dense on the mesonotum; pleuræ and pectus polished and shining; thoracic sutures more or less distinctly crenulated; scutellum flavous, deeply excavated in front and connected with the mesonotum by two longitudinal carinæ; metathorax dull fulvous, with dense short pubescence, flat behind, with a distinct median furrow from which numerous arcuate furrows extend to the insertion of the abdomen, and two short lateral carinæ originating near the apex; wings bright fulvous, transparent, the apex with a broad fuscous band; stigma lacking; basal half of costa fulvous; nervures otherwise fuscous; nervulus interstitial; nervellus broken well above the middle; first recurrent vein about one-third the length of the second; outer two-thirds of the discocubital vein nearly parallel with the subdiscoidal vein.

Four anterior legs fulvous, excepting their tarsi, which are black; posterior legs black, with the base and apex of the femora ferruginous; in one specimen these two bands are connected by a narrow longitudinal stripe of the same color; abdomen shining black, strongly compressed.

In describing this species I have compared three specimens with the original description.

Type.—♀. Location unknown.*

This is one of the largest species of *Thyreodon*, and may be readily recognized by its contrasting colors. It apparently varies somewhat in the size of the ocelli. I have before

* Schulz states that it is not at the Münich State Museum.

me specimens with the small ocelli characteristic of *Thyreodon*, but Schulz seems to have had specimens with large ocelli, for he believes that *spectabilis* belongs to the Genus *Athyreodon*. Dr. Schmiedeknecht's description of *A. apicalis* agrees with *spectabilis* except for the large ocelli. Judging from this and from a specimen before me in which the ocelli are larger than in normal Thyreodons—though not so large as in *A. thyreodon*, I believe that *T. spectabilis* forms the connecting link between *Thyreodon* and *Athyreodon*, and that the size of the ocelli is not as yet well fixed.

Distribution.—This species apparently ranges from Panama to southern Brazil. It was described from Brazil at the Rio Negro, and I have before me specimens from Chauchamayo, Peru, and Hermira Falls, Surinam, Dutch Guiana, sixty miles up the Maroni River. Nothing is recorded of its life history, habits or hosts.

Location of specimens.—U. S. National Museum, two ♀'s, Chauchamayo, Peru; Surinam, Dutch Guiana. Massachusetts Agricultural College, Peru. British Museum.

Thyreodon grenadensis Ashm.

Thyreodon grenadensis Ashmead, Trans. Ent. Soc. Lond., p. 270, n. 179.....1900.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 11.....1905.

Length, 34 mm. ♀.

Head, thorax, two basal segments of the antennæ and four anterior legs, except their tarsi and hind coxæ, ferruginous; eyes, flagellum of antennæ, hind legs, except coxæ, and abdomen, black; wings hyaline, with a smoky cloud at the basal third enclosing the apex of the submarginal cell and basal vein, and another enclosing the marginal cell, except a small space at its base.

I have not seen the type or a specimen of this species, and can only give the original description.

Type.—♀. Location unknown.*

I am not sure of the identity of this species, and it may

* It has not been found at either the British Museum or U. S. National Museum, but may possibly be found in Dr. Ashmead's private material.

prove to be synonymous with *A. atriventris*. It certainly resembles this species in structure and color, but as Dr. Ashmead placed it in the Genus *Thyreodon* instead of *Athyreodon*, it must be considered as possessing the small ocelli characteristic of *Thyreodon*.

Distribution.—Isle of Grenada (Balthazar).

Thyreodon maculipennis Cress.

Thyreodon maculipennis Cresson, Proc. Acad. Nat. Sci. Phila., p. 375, n. 2, ♀ ♂.....1873.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 13.....1905.

Black; wings black, with a purplish reflection and a hyaline spot in the discocubital and third discoidal cells.

Length, 25–26 mm.; wing, 17–18 mm.; spread, 26–29 mm.

Shining black, with a more or less distinct purplish reflection; clothed with fine short pubescence; ocelli flavous, medium sized, with a median keel running from the anterior to or a little below the bases of the antennæ; eyes emarginate, medium sized; clypeal foveæ distinct;

Thorax finely pubescent; mesonotum with parapsidal furrows weak. pleuræ and pectus smooth and polished; metathorax flat behind, with a median longitudinal furrow and numerous arcuate carinæ originating about the insertion of the abdomen,

Wings violaceous black, the anterior pair with a hyaline spot in the discocubital and third discoidal cells; nervulus antefurcal to interstitial; nervellus broken above the middle.

Legs and abdomen shining black.

In describing this species I have compared the cotypes with the original description. The antennæ are missing.

Cotypes.—Two ♀'s and one ♂. No. 70, Mexico, American Entomological Society.

This species is closely related to *T. morio transitionalis*. *T. maculipennis* may be separated by the violaceous reflection of the body and wings, which indicates that it is related to and may be a subspecies of *T. cyaneus* or *grandis* with similar variation from the species to that of *transitionalis* from *morio*. The antennæ of all the cotypes are, however, missing, so that I am unable to decide this question.

Distribution.—This species has been reported from Cordoba and Orizaba, Mexico, and probably ranges into Central America.

Thyreodon marginipennis Br.

Thyreodon marginipennis Brullé, Hist. Nat. Ins. Hym., IV, p. 152, n. 3, ♂ .....1846.
Ophion marginipennis Taschenberg, Zeitschr. f. d. Ges. Natur., 46, p. 425, n. 3.....1875.
Thyreodon marginipenne Holmberg (E. L.), Anal. Soc. Cient. Argent., 18, Pt. 5, p. 227, n. 37 .....1884.
" *marginipennis* Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 14.....1905.

Black; wings flavo-ferruginous, with the apex fuscous; nervures reddish except in the smoky portion; metathorax strongly rugose.

Length, 25 mm.

Head with face strongly rugose, the interantennal fossa with its edge much raised; basal segment of the antennæ red, the second red at the outer end, the remaining segments black; mandibles with the middle reddish ferruginous; metathorax very finely punctate; the median lobe of the mesonotum raised in the middle and finely rugose the whole length of the deep parapsidal furrows; metathorax strongly rugose, without median dorsal furrow; metanotum and pleuræ a little flattened. Scutellum strongly punctate; wings light yellow to ferruginous, apex smoky, in the manner of a transverse band; nervures red except in the smoky portion where they are brown, their arrangement as in *T. morio* Fabr.; legs and anterior tarsi reddish-brown; abdomen black, anal valves truncate.

Type.—♀. Location unknown to me.

I have not seen the type or a specimen of this species, and can only give the original description as modified by Holmberg who writes as follows:

"Brullé cites this species from Buenos Ayres, from where I also received it, and the only one, but he says nothing of the brilliant steel-blue of the specimen seen under certain conditions of light. He notes that the wings are washed with yellow, but I have before me one where they are lion-colored or ferruginous; he had a mutilated male specimen, and that is the one which I examined."

Distribution.—Buenos Ayres, Argentina.

Thyreodon flammipennis Ashm.

Thyreodon flammipennis Ashmead, Proc. Cal. Acad. Sci., IV, p. 125, n. 10, ♀.....1894.
" " Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 8.....1905.

Black; wings bright fulvo-ferruginous, the tips margined with fuliginous; head and thorax opaque and closely punctate.

Length, 23–32 mm.; wing, 25 mm.; spread, 54 mm.

Black; head and thorax opaque and closely punctate; head transverse, a little narrower than the thorax; ocelli small, distant from the tops of the eyes; eyes slightly emarginate, medium sized, broad, at some distance from the base of the mandibles; antennæ extending to the apex of the petiole of the abdomen;* face with a median carina extending from between the bases of the antennæ, where it is most pronounced, nearly to the apex of the clypeus, where it is more or less obliterated; labium produced; mandibles black, sometimes more or less flavous; thorax opaque and closely punctate except the sternum, pleuræ and sometimes the back of the mesonotum, which are shining; mesonotum with parapsidal furrows indistinct or lacking; metathorax opaque, rugose behind, the sides closely punctate and more or less shining.

Wings bright fulvo-ferruginous, the apex and sometimes a spot at the base fuliginous; nervulus interstitial; nervellus broken above the middle; abdomen smooth and shining, the segments beyond the third sometimes aciculate.

In describing this species I have compared one specimen from Mexico with the original description.

Type.—Location,† California Academy of Science.

This species is related to *T. marginipennis* and may prove to be synonymous; it is also related to *T. morio*, but may be readily recognized by the bright fulvo-ferruginous wings. Dr. Ashmead remarks that it evidently mimics some of the spider-killing wasps (Ceropalidæ, *Pompilus* and *Pepsis*), but nothing is known of its life history or habits.

Distribution.—This species probably ranges through southwestern United States and Mexico. It was described from California, and I have before me a specimen from Mexico.

Location of specimens.—American Entomological Society, Mexico.

* Dr. Ashmead does not particularly mention the color of the antennæ, hence it appears that they are black, but I have before me an otherwise characteristic specimen of this species in which at least the basal two-thirds of the flagellum (the rest is missing) is fulvous, the scape black. This question can not be definitely settled now as I have been unable to locate the type in time to get any information on the subject, but there is possibly some variation in this character.

† Collected by Mr. Eisen of the California Academy of Science, and now located with that part of the collection saved from the earthquake and fire of 1906, at 1219 F street, Topham, Cal.

Thyreodon fernaldi n. sp.*

Black; antennæ orange-fulvous, face and legs more or less fulvo-ferruginous; abdomen with third and fourth segments, sometimes part of the second and fifth segments, ferruginous; wings fuliginous, with basal two-thirds of the anterior and a small spot on the posterior fulvous or fulvo-fuscous.

Length, 38–45 mm.; wing, 24–29 mm.; spread, 51–62 mm.; antennæ, 22–29 mm.

Black, clothed with fine short pubescence; head and thorax closely and finely punctate; head black, more or less varied with fulvous or ferruginous; ocelli small, distant from the tops of the eyes; eyes large, emarginate, antennal fossæ deep; antennæ orange-fulvous, with the scape sometimes fuscous to black; clypeal foveæ distinct; clypeus weakly pointed; mandibles broad and stout.

Thorax black; metathorax opaque; pleuræ and pectus shining; mesonotum opaque or semi-opaque; parapsidal furrows weak, double; scutellum excavated in front, with strong lateral carinæ connecting it with the mesonotum; metathorax finely reticulate, with short pubescence, flat or very slightly hollowed behind.

Wings fuliginous, with the basal two-thirds to the apex of the closed cells of the anterior and a small spot in the median and radial cells of the posterior fulvous or fulvo-fuscous; nervulus antefurcal to interstitial, in one specimen very slightly postfurcal; nervellus broken well above the middle.

Legs more or less fulvo-ferruginous; coxæ, femora and feet often black; abdomen black, with the third and fourth and often part of the second and fifth segments ferruginous, smooth and shining, with fine, short, pubescence; ovipositor reddish; male claspers with outer two-thirds narrowed; apex pointed.

Described from three ♀ and one ♂ cotypes.

Cotypes.—♀ and ♂. Mexico, U. S. National Museum; ♀, Arizona, American Entomological Society; ♀, Colorado, Brooklyn, Museum.

This species is related to *T. morio* and its subspecies *transitionalis* as well as to *T. laticinctus* and *zonatus*. It is, however, larger than *morio*, with the abdomen more slender, and may be readily recognized by the fulvo-hyaline spot on the wings and the ferruginous band on the abdomen. Both of these vary somewhat in extent but seem to be characteristic.

Distribution.—Colorado; Arizona; Mexico.

This species apparently ranges through the mountainous

* Named in honor of Dr. H. T. Fernald.

district of southwestern United States and Mexico, possibly into Central America. The cotypes were taken in Colorado; Huachuca Mountains, Arizona; and Meadow Valley, Mexico. Nothing is known of the life history, habits or hosts.

Thyreodon morio transitionalis Vier.

Thyreodon morio transitionalis Viereck, Trans. Amer. Ent. Soc., 32, p. 225.....1906.

Black; face, mouth parts and legs sometimes more or less fulvous, or tinged with black, with a flavo-hyaline spot in the discocubital and third discoidal cells of the anterior wing and sometimes a second in the marginal cell of the posterior wing

Length, 25–35 mm.; wing, 15–25 mm.; spread, 32–53 mm.; antennæ, 15–23 mm.

This subspecies differs from *morio* in having the basal third of the radial cell, most of the discocubital and third apical cells of the anterior wing, and sometimes the marginal cell of the posterior wing, fulvo-hyaline; the size of these spots varies somewhat, and the head and legs are sometimes more or less flavous or fulvous tinged with ferruginous as in *morio*.

In describing this species I have examined five specimens.

Type.—University of Kansas.

This form is too closely related to *morio* and the fulvo-hyaline spots too inconstant to permit of more than subspecific rank. Owing to lack of material I am unable to determine the limits of this variation, but *T. snowi* is certainly related and may prove to be a continuation of this. *T. maculipennis* is also closely related, but the wings and body have a more or less distinct violaceous reflection.

Distribution.—The range of this subspecies is probably similar to that of *T. morio*, from southern Canada to Central America. The type was taken at Oak Creek Cañon, Arizona, at 6,000 feet, and I have before me specimens from Sarcoxie, Missouri, and Riley County, Kansas; Lake Itasca, Minn.; and also from Amherst, Mass. The life history, habits and hosts are unknown, but probably agree with those of *T. morio*. The two Kansas specimens were taken June 1 and July 2, one from Minnesota in July, and those from Amherst June 20 and 29, while the type was taken in July at 6,000 feet.

Location of specimens.—University of Kansas, ♀ type, Oak

Creek Cañon, Arizona, 6,000 feet. U. S. National Museum, Sarcoxie, Missouri; Jefferson County and Riley County, Kansas. Massachusetts Agricultural College, Amherst, Mass. Minnesota Agricultural College, ♀, Lake Itasca.

Thyreodon erythrocerus Cam.

Thyreodon erythrocera Cameron, Biol. Centr. Amer., Hym., I, p. 288, n. 2, pl. 12, fig. 13.....1886.
" *erythrocerus* Dalla Torre, Cat. Hym., III, p. 185.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 6.....1905.

Body and wings black; antennæ reddish, with base and apex black. Length, 32 mm.

Head closely covered with black hair; vertex almost impunctate; antennæ reddish, with base and apex black; eyes distinctly margined, the hollow over the antennæ with large, curved, transverse striations; face deeply punctured; clypeal foveæ deep and longish; mandibles and palpi covered with long brownish hair.

Thorax opaque above; mesopleura impunctate and shining; mesonotum everywhere closely and distinctly punctured, scutellum shining and punctured, but not so closely; keels in front of the scutellum closely striate; metathorax opaque, depressed at the base and bulging somewhat at the sides, hollowed in the center behind, the depression widest at the apex; metanotum closely and transversely, the pleuræ more strongly, striated.

I have not seen a specimen of this species, and can only give the original description slightly rearranged.

Types.—♀ and ♂. British Museum.

Cameron writes: "This species has the deep black body, wings and reddish antennæ (black at the base and apex, of *T. morio*) Fabr. and *T. gracilis** Cr., but is probably distinct from either." After carefully considering the variation in the different species of *Thyreodon* I believe that this species is synonymous with *T. grandis* Cress., but as I have not seen the type or a specimen I have preserved it for the present.

Distribution.—Mexico; Valladolid in Yucatan.

* I find no other reference to *Thyreodon gracilis*, and this is probably a typographical error, the species referred to being *T. grandis*. It is possible that *T. gracilis* may have been given as a manuscript name, but it apparently never passed that stage.

Genus **OPHIOMORPHA** Szep.

Ophiomorpha Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 34.....1905.

Head narrowed behind the eyes; clypeus more or less rounded, not separated; eyes and ocelli large. Parapsidæ lacking or indistinct, scutellum bordered; basal section of radial vein thickened and bordered, the end section bowed; nervus parallelus inserted above; nervellus broken below the middle. Radial vein of hind wings straight. Claws pectinate. Abdomen compressed, second segment seldom shorter than the first.

Generic type.—*O. curvinervis* Cam.*

I have not seen either of the two species in this genus, and can therefore give only a free translation of the general characters of the genus. It is, however, closely related to *Eremotylus*.

Distribution.—Brazil; Guatemala.

Nothing is known of the life history, habits or hosts of the members of this genus.

Table of Species.

Antennæ brown or brownish, stigma yellowish red.....**bicolor** Szep.
Antennæ black, flagellum more or less brownish beneath, scape sometimes yellow beneath, stigma clay-yellow.
curvinervis Cam.

Ophiomopha bicolor Szep.

Ophiomorpha bicolor Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 35, n. 2.....1905.

Length, 25 mm.

Face very finely punctured; antennæ as long as the body. Mesonotum smooth, flat; mesopleuræ shining, weakly wrinkled below; metapleuræ leathery; metanotum with uneven projections on each side and a transverse band, the sides bordered, the middle part irregularly transversely wrinkled; nervulus antefurcal. Second segment of abdomen as long as the first, yellowish red; antennæ brownish or brown; abdomen from the third segment on brown—excepting the anterior upper part of the third—or black, the third and fourth segments with oblong yellow spots on the sides. Wings light yellowish, nervures and stigma yellowish red.

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* Since the generic type is not designated the case is governed by the International Code, Art. 30, according to which preference should be given to the best described, best figured, best known, most easily obtained species or one of which a type can be obtained. Following this recommendation I indicate *O. curvinervis* Cam. as generic type.

I have not seen a specimen of this species, and can only give a free translation of the original description.

Type.—♀. Location unknown to me.

Distribution.—Brazil.

Ophiomorpha curvinervis Cam.

Ophiomorpha curvinervis Cameron, Biol. Centr. Amer., Hym., I, p. 293, pl. 12, fig. 19, ♀.....1886.

Luteous; head, pleuræ and scutellum flavous; wings hyaline; stigma luteous; antennæ blackish brown.

Length, 29–31 mm. ♀.

"Antennæ as long as, if not longer than, the body; black, the flagellum more or less brownish on the lower side, the scape sometimes luteous beneath. Head shining, obscurely punctured, not much projecting in the middle; clypeal foveæ deep, longish. Thorax covered with close pale pubescence. Mesonotum very minutely punctured; the pleuræ finely longitudinally striated. Scutellum carinate along the sides. Metanotum with one transverse keel near the base; the base behind it finely rugose; the rest of the surface finely rugose and bearing arcuate keels. Metapleuræ finely rugose. Petiole shining, glabrous, slightly hollowed in the center above at the base; postpetiole clearly separated from and distinctly thicker than the petiole, densely covered with a white pubescence; the petiole itself is narrowed at the apex; together they are nearly as long as the second segment, which is dilated at the apex. The transverse radial nervure is curved upwards in the middle on the basal division, the apical portion having a gradual curve from the base to the apex, the extreme apex curved upwards; the angle formed at the apex of the first cubital cellule shorter on the upper than on the lower side."

I have not seen a specimen of this species, and can only give the original description.

Type.—British Museum.

Distribution.—Las Mercedes, 3,000 feet, Senahu, Guatemala.

Genus **EREMOTYLUS** Först.

Eremotylus Förster, Verh. Preuss. Rheinl., 25, p. 150, n. 8.....1868.
Allocamptus Thomson, Opusc. Ent., 12, p. 1189.....1888.
" Brauns, Arch. Nat. Mecklenb., XLIII, p. 97.....1889.
Eremotylus Brauns, Idem, p. 98.....1889.
Allocamptus Dalla Torre, Cat. Hym., III, p. 180.....1901.
Eremotylus Dalla Torre, Idem, p. 184.....1901.
Camptoneura Kriechbaumer, Zeitschr. f. Syst. Hym. Dipt., I, p. 22..1901.
Leptophion Cameron, Proc. Zool. Soc. Lond., 227.....1901.

Eremotylus Felt, N. Y. State Mus., Bull. 76, Nineteenth Rept. State Ent., p. 101 ..... 1904.
" Szepligeti, Gen. Ins., Hym., 34me Fasc., pp. 22, 35... 1905.
Allocamptus Szepligeti, Idem, pp. 22, 36 ..... 1905.
" Schulz, Spolia Hym., p. 277 ..... 1906.
" Schmiedeknecht, Hym. Mitteleurop., p. 594 ..... 1907.
Eremotylus Schmiedeknecht, Idem ..... 1907.
Cymatoneura Schmiedeknecht, Opusc. Ichn., XVIII, p. 1419, n. 15, p. 1423, n. 29; XIX, p. 1449, n. 7 ..... 1908.
Eremotylus Schmiedeknecht, Idem, XVIII, p. 1423, n. 29; XIX, p. 1450, n. 8 ..... 1908.

Discocubital cell without maculæ; discocubital vein never angularly broken or appendiculate; radial vein once or twice bent or angularly broken; nervellus broken usually below the middle; claws pectinate.

Generic type.—E. marginatus Jur. (Brauns, monotypical).

The genus *Eremotylus* as proposed by Förster included in a general way the Ophionini outside of the two genera *Ophion* (under which many entomologists even as late as 1875 included *Thyreodon* and what is now known as *Athyreodon*) and *Enicospilus*. This genus was proposed in a key and the characters given were:

"Wings without areola; discocubital vein not angularly broken; cubital cross vein straight, with the cubital vein uniting in a very pointed angle, the latter running from the head of the angle to the tip of wing; discocubital cell without dark colored spots."

Thomson evidently did not know of this genus, or did not consider it valid—as no species had been designated—for he does not mention it, but proposes *Allocamptus* as a subgenus of *Enicospilus* and practically equivalent to Förster's *Eremotylus*. He separates his subgenus from *Enicospilus* by the absence of maculæ, and the radius being twice bent. The characters given are:

"Wings without membranaceous maculæ but the base of the radius strongly bent, nervulus and nervellus well antefurcal, metathorax with rudimentary angular area below, broadly excavated behind, narrowed transversely; mesosternum granulose-punctate, emarginate behind, foveæ below the punctured speculum impressed."

In 1889 Brauns revised this group of insects, restricting *Eremotylus* and *Allocamptus* but retaining both and separating them by the character of the radius, this being once bent

in *Eremotylus* and twice bent in *Allocamptus*. As the first revision this must be accepted (International Code, Article 28) if the two genera are retained. Kriechbaumer and Schmiedeknecht also retain the two genera* with practically the same generic differences, which are:

"Metathorax with only one weak transverse carina; base of radius doubly bent, mesosternum granularly punctured, nervulus and nervellus plainly postfurcal.

Allocamptus Thoms. (*Cymatoneura* Kriechb.).

Metathorax with an anterior carina strongly raised in the middle, more or less strongly reticulate; base of radius once bent.

Eremotylus Förster (*Camptoneura* Kriechb.)."

Examinations made of a long series of specimens show that none of these supposedly generic characters are constant in the American species which I have seen. The anterior metathoracic carina varies in shape and size throughout, as does the amount of the reticulation of the metathorax. The amount of flexure of the base of the radius shows similar variation, and a good series of *E. macrurus* and *E. arctiæ* furnishes specimens which show a complete gradation from the once-bent to the twice-bent condition. In *E. texanus* Ashm. we find a similar variation, while *macrurus* and *angulatus* and *flavofuscus* with its subspecies *radialis* show variation along another line, the radius being angularly broken. Specimens of *E. macrurus*, *E. arctiæ*, etc., show that differences in punctation of the mesosternum appear equally in all the species. The nervulus is interstitial or prefurcal—sometimes well prefurcal—and the nervellus is broken well below the middle, in all American specimens of this group which I have seen, not as Schmiedeknecht says, "plainly antefurcal in *Allocamptus*." These differences described by Schmiedeknecht and others may be fixed in the European species, allowing a division into two genera, but they certainly are not in the American forms and are therefore of only specific value. There is undoubtedly variation along the lines of radius once-bent and twice-bent as shown in *macrurus* and

* Kriechbaumer proposes the name *Cymatoneura* to take the place of the generic name *Allocamptus* Thoms., which was preoccupied by *Allocamptus* Förster.

arctiæ, but there is also variation of the radius angularly broken as shown in *flavofuscus* and others. The shape of the radius is therefore quite variable, like the other characters considered above, For these reasons and from general observation and comparison I believe that the species are too closely related, and the diverging characters as yet too variable to permit their separation into two genera. I have therefore united the two genera, *Eremotylus* and *Allocamptus*, under *Eremotylus* Förster, the oldest valid generic name.

Förster, when proposing *Eremotylus* in 1868, gave its generic characters in a table but designated no species under it, and none was placed there till 1889, when Brauns designated *Eremotylus marginatus* Jur. (Arch. Nat. Meckl., 43, p. 98). The genus *Allocamptus*, was proposed by Thomson in 1888 as a subgenus of *Enicospilus*, and *Ophion undulatus* Grav. was placed as a member. In 1889 (Arch. Nat. Meckl., 43, p. 97) Brauns raised it to generic rank including the same species.*

The generic name *Allocamptus* was, however, preoccupied by *Allocamptus* Förster 1868, and as a homonym can not stand even though the latter has proved to be a synonym a *Enicospilus* Steph.†

Kriechbaumer recognized this fact, and in 1901 (Zeitsch. Hym. Dipt., I, p. 18) proposed the name *Cymatoneura*, which should supersede the generic name *Allocamptus* Thoms. if that genus was valid. In uniting these two genera I have followed the International Code of Nomenclature (Art. 28), by which "a genus formed by the union of two genera or subgenera takes the oldest valid generic name of its components. If the names are of the same date, that selected by the first reviser shall stand," and have preserved the generic name *Eremotylus* Förster, considering that since the name

* This description of the genus *Allocamptus* Thoms. and designation of type are given in the same volume, only one page ahead of a description of—not the original—and designation of the type for the genus *Eremotylus* Förster,

† Internat. Code Nom., Arts. 34, 36; "A generic name is to be rejected as a homonym when it has previously been used for some genus of animals."

Allocamptus Thomson was a homonym, the genus was not valid until a new name was proposed by Kriechbaumer in 1901. Others may determine the delicate question whether *Eremotylus* Förster should date from 1868 or 1889, but I consider it as certainly established in 1889, when a species was first designated. I recognize the movement in favor of a rule that no generic name shall have standing until a recognizable species has been placed under it, although this is not as yet adopted by the International Commission on Zoological Nomenclature. Until the adoption of such a rule it would seem that *Eremotylus* Först. must hold. Such a rule would, however, eliminate the generic names *Eremotylus* and *Allocamptus* of Förster, and *Allocamptus* Thomson would then become the generic name for this group.

Distribution.—The species of this genus are widely distributed from the southern part of boreal North America to the southern part of South America, including the West Indies. *E. macrurus* has perhaps the widest range, having been taken from Ottawa, Canada, to Central America and Trinidad. The distribution of the other species is not as yet well known, but is apparently more limited.

Life history and habits.—Little is known of the life histories of the members of this genus, except for *E. macrurus*, but they probably differ little from that of this species, which is treated under the general heading for the tribe and the species.

Economic importance.—The host list of most of the members of this genus is very incomplete, but so far as known they are parasitic upon the Arctiidæ and Saturniidæ and one species of Notodontidæ. *E. macrurus* is a common parasite of the large cecropia larvæ and allied species, and the control of these is undoubtedly due to the activity of these parasites. The importance of *E. macrurus* is, however, somewhat diminished by the fact that it often fails to make a proper pupa; the late Dr. J. B. Smith reported a case in which but 19 adults were obtained from 79 pupæ. "In some localities, at least, sound larvæ and pupæ are the exception, and one usually finds on cutting the cocoon only a putrid brown, semi-

liquid mass. This indicates that this parasite is kept in check by some disease that reaches it within the body of the host." Investigations at the Gypsy Moth Laboratory show that *macrurus* is often the victim of other parasites of the same host, or of secondary parasites.

Variation.—The members of this genus seem to be among the most variable of the American representatives of the tribe. Variation in size and venation is quite marked, especially in *E. macrurus* L. Here the size runs from 22–36 mm.; the color varies from ferruginous to flavous with all intermediate gradations; the wings vary from a complete fulvous to hyaline—the color seems to be most permanent at the base, disappearing first at the apex and working towards the body. Variation in color works, as always, in two directions, (1) towards the light or albinic and (2) towards the dark or melanic. Most specimens are fulvo-ferruginous, with a distinct fulvous tinge in the wings, but throughout the entire range there are always a few of the light forms. These seem to be more numerous, however, in southern United States and Mexico. The melanic forms do not seem to show as great variation, but *E. texanus* greatly resembles *macrurus*, and may prove to be a melanic form. Its fuscous wings and dark ferruginous body, more or less marked with black, seem, however, to be sufficiently fixed to be considered specific, yet this can not be finally settled until breeding experiments have been carried on. In venation the radius may be as in *macrurus*, enlarged at the base and in some specimens doubly bent, but a good series generally shows a gradation to the once-bent condition seen in *E. arctiæ*. In *macrurus*, *angulatus*, and *flavofuscus* the radial vein is angularly broken about 1 mm. from the stigma. The angularly broken radial vein is, I believe, the older condition, showing where the first transverse cubital nervure branched off. Breeding experiments may show that *arctiæ* is only a subspecies of *macrurus*, but the species as I have restricted it seems to have well fixed characters. The variation in size may be easily explained by a difference in the amount of food supply of the larva. Similar variation in

color occurs in most orders, and Tower's explanation may prove to be the right one here.*

Table of Species.

1. Wings fuliginous or infuscated, eyes small, only slightly emarginate.....11.
   Wings hyaline or tinged with fulvous, eyes distinctly emarginate..2.
2. Abdomen with the apex dark brown or black.....3.
   Abdomen with the apex not dark brown or black.....6.
3. Abdomen beyond the second or third segments black.
   rufoniger n. sp.
   Abdomen beyond the second or third segments dark brown.....4.
4. Base of radial vein angularly broken.....**flavofuscus** Br.
   Base of radial vein not angularly broken.....5.
5. Mesonotum with three black stripes (thorax luteous).
   flavofuscus radialis n. subsp.
   Mesonotum without three black stripes.....10.
6. Base of radial vein thickened.....7.
   Base of radial vein narrowed (near the stigma).....8.
7. Stramineous, wings hyaline.....**stramineus** Tasch.
   Fulvo-ferruginous to flavous, wings usually tinged with fulvous.
   macrurus L.
8. Base of radial vein angularly broken.....**angulatus** n. sp.
   Base of radial vein not angularly broken.....9.
9. Apex of antennæ fuscous.....**tenuigena** Kriechb.
   Apex of antennæ not fuscous.....10.
10. Discocubital vein arcuate, wings hyaline.....**arctiæ** Ashm.
    Discocubital vein sinuous, wings usually tinged with fulvous.
    macrurus L.
11. Testaceous, nervellus broken far above the middle.
    infuscatus Tasch.
    Ferruginous, nervellus broken below the middle...**texanus** Ashm.

Eremotylus rufoniger n. sp.

Ferruginous; antennæ fuscous to black; vertex flavous; stigma fulvous; radial vein with the basal half thickened and angularly broken two mm. from the stigma.

Length, 20–25 mm.; wing, 17–19 mm.; spread, 36–40 mm.; antennæ, 25–28 mm.

Head reddish-yellow to rufous; vertex flavous; antennæ fuscous to black, as long or longer than the body; ocelli large, prominent, well

* Tower, *Evolution of Leptinotarsa*, p. 214: "(a) The factors most potent in the modification of coloration are temperature and moisture; soil and altitude act indirectly through moisture and temperature, while the influences of food, light and other factors are very slight."

separated; eyes large, emarginate; clypeal foveæ deep; body clothed with fine short pubescence.

Thorax fulvo-fuscous; mesonotum fuscous; mesopleuræ with a glabrous area just below the base of the wings; metathorax slightly hollowed behind, with weak anterior transverse carina, in front of which the surface is smooth, behind with median longitudinal carinæ from which others run out and down.

Wings hyaline, slightly tinged with fulvous; stigma fulvous; nervures fuscous to black; radial vein with its basal half thickened and angularly broken 2 mm. from the stigma; discocubital vein bent; nervulus antefurcal to interstitial; nervellus broken far below the middle; first recurrent vein three-fourths as long as the second.

Legs fulvous; abdomen with the two basal segments fulvo-rufous, the remaining segments black.

Described from two female cotypes.

Cotype.— ♀. Chauchamayo, Peru, U. S. National Museum; ♀, Pozuzo, Peru, U. S. National Museum.

This species is related to *flavofuscus* Br. but is darker colored and the fuscous on the abdomen of *flavofuscus* is here replaced by black; while the body is rufo-fuscous instead of flavous as in the latter. This may be only a subspecies of *flavofuscus* but appears to be a good species with the characters well fixed. In one of the cotypes most of the head is fuscous.

Distribution.—Chauchamayo, Pozuzo, Peru. It probably ranges farther north and south.

Eremotylus flavofuscus (Br.).

Ophion flavo-fuscus Brullé, Hist. Nat. Ins., Hym., IV, p. 139, n. 4, Brazil.....1846.
" *flavofuscus* Dalla Torre, Cat. Hym., III, p. 191.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 100, listed.....1905.

Glauco-flavous; abdomen beyond second segment fuscous; antennæ flavo-fuscous; wings hyaline, radial vein angularly broken near the base; mesonotum with three longitudinal fuscous stripes.

Length, 21–32 mm.; wing, 17–20 mm.; spread, 36–43 mm.; antennæ, 20–25 mm.

Head and thorax glauco-flavous; eyes and ocelli ferruginous to fuscous; ocelli (often with an outer ring of flavous) large, prominent, well separated, the two posterior close to the tops of the eyes; eyes emarginate; antennæ fulvo-ferruginous, often fuscous, especially at the tips, long, filiform, with a small, indistinct median tubercle below and between their bases; clypeal foveæ distinct; mandibles bidentate, tipped with black.

Thoracic sutures, pectus and coxæ sometimes ferruginous; mesonotum smooth, with three broad longitudinal fuscous stripes of equal length, the median half its length in front of the others; scutellum prominent, convex, hollowed in front, and bordered with lateral keels connecting with the mesonotum; metathorax with an anterior transverse carina, in front of which it is smooth, behind wrinkled, with a shallow median longitudinal furrow and arcuate carinæ originating around the insertion of the abdomen.

Wings hyaline, sometimes slightly tinged with fulvous; nervures flavo-fuscous, stigma flavous; radial vein angularly broken about 1 mm. from the stigma, thickened beyond the break; discocubital cell with a small glabrous area inclosing one or two indistinct, colorless, irregular spots; discocubital vein sinuous; nervulus antefurcal; nervellus broken well below the middle.

Legs fulvous, claws pectinate.

Abdomen smooth and shining; beyond the first or second or middle of third segment fuscous, the remainder flavous; the whole body sparsely clothed with fine short pubescence.

Redescribed from two females; one male specimen from Peru compared with the original description.

Type.—Location unknown.

Distribution.—Brazil; Haituba, Peru.

This species is evidently tropical, having been taken in Brazil and Peru, and probably inhabits Bolivia and Ecuador, possibly going into Colombia, Venezuela, and Guiana. I can find no reference to this species since Brullé's original description of a specimen from Brazil, but there are in the Massachusetts Agricultural College collection several specimens from Peru which seem to agree with Brullé's description.

Life history.—I can find no reference to the life history, habits or hosts of this species, and hence can give no idea of its economic value as a parasite.

Location of specimens.—Massachusetts Agricultural College, two ♀'s and one ♂ from Peru.

Eremotylus flavofuscus radialis n. subsp.

I consider as a subspecies two female specimens from Peru which differ from *flavofuscus* in that the radial nervure is evenly bent, not angularly broken.

Cotypes.—Two ♀'s, Peru, Massachusetts Agricultural College.

Eremotylus stramineus (Tasch.).

Ophion stramineus Taschenberg, Zeitchr. Ges. Nat., Vol. 46, p. 431, n. 13, ♀, America borealis.....1875.
" " Dalla Torre, Cat. Hym., III, p. 199..... .....1901.
Allocamptus stramineus Szepligeti, Gen. Ins., Hym., 34me Fasc., pp. 22, 36.....1905.

Stramineo-flavous; sericeous, wings hyaline; nervures straw-yellow; metanotum very finely rugose.

Length, 22 mm.

Pale yellow, approaching ripe straw-color; mesonotum with two weak longitudinal carinæ and metathorax with weak anterior transverse carina and very finely rugose; wings hyaline, base of radius thickened and twice bent, discocubital nervure arcuate, nervellus broken well below the middle. Apex of abdomen generally darker, appearing somewhat spotted. In consequence of the finer wrinkling of the mesonotum, the lighter color, complete transparent wings and smaller size it appears more delicate than *Eremotylus undulatus*.

I have not seen a specimen of this species, and can therefore give only a free translation of the original description.

Type.—Location unknown.

This may prove to be a synonym of *macrurus*, but as I have not been able to see the type or secure material I have given the contents of the unfortunately incomplete original description. I can find no other reference to this species and nothing seems to be known of its life history, habits or hosts.

Eremotylus angulatus n. sp.

Plate. II, fig. 13.

Fulvous; wings hyaline or slightly fulvous; radial vein angularly broken 2 mm. from the stigma.

Length, 38 to 45 mm.; wing, 39 to 45 mm.; spread, 80 to 92 mm.; antennæ, 20 to 22 mm.

Fulvous to fulvo-ferruginous, with head occasionally sulphur-yellow; wings hyaline or slightly tinged with fulvous.

This species resembles *E. macrurus*, but the abdomen is more slender, and it may be readily recognized by the angularly broken radial vein.

Described from three female cotypes from Porto Rico.

Habits.—This species evidently preys upon a number of lepidopterous larvæ. The writer has recently bred it from black wooly-bear caterpillars at Mayaguez, Porto Rico. The

oval pupa of dark brown silk, 12 mm. long by 6 mm. broad, is formed within the skin of the host several days subsequent to its death. One larva spun up in this way on February 13 and the adult emerged March 15, a period of thirty-one days being required for the transformation.

Location of specimens.—Cotypes: American Entomological Society (Academy of Natural Sciences, Philadelphia); Agricultural Experiment Station, Mayaguez, Porto Rico; Massachusetts Agricultural College.

Distribution.—Porto Rico.

Eremotylus tenuigena Kriechb.

Eremotylus tenuigena Kriechbaumer, Zeitchr. Syst. Hym. Dipt., p. 153, Santos, Brazil.....1905.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 36, n. 7.....1905.

Fulvous, head in part and scutellum flavous, apical half of antennæ fuscous; mesonotum with three carinæ; metanotum with two lateral subtriangular fuscous spots; the head roundly narrowed behind the eyes; ocelli large, close to tops of the eyes.

Length, 23–25 mm.; antennæ, 27 mm.

Fulvous; head varied with flavous; face narrow; cheeks narrow, flattened; face and clypeus together twice as long as broad; ocelli large, well separated, close to tops of eyes, arranged as an isosceles triangle; apical two-fifths of antennæ fuscous, especially above.

Mesonotum with two longitudinal furrows converging on the scutellum, dividing it into three lobes: keels more or less distinct on the lateral lobes; scutellum flavous, with lateral keels connecting it with the mesothorax in front with an inconstant rounded lateral fuscous spot at the base; metathorax short, with anterior transverse carina, sometimes stronger in the middle, running at the sides into a small protuberance; shallowly excavated behind, with irregular arcuate wrinkles and a varying bronze reflection most constant below, as well as an irregular, somewhat ragged lateral fuscous spot.

Wings with the base of the radial vein somewhat "drawn out."

This species resembles *E.* (*Allocamptus*) *undulatus* Grav. I have not seen a specimen, but give a free translation of the unfortunately incomplete original description from the German.

Type.—Collection of Dr. Hans Brauns.

Distribution.—Santos, Brazil.

This species is evidently semitropical, as the type was taken at Santos, Brazil, just south of the Tropic of Capricorn.

Eremotylus arctiæ Ashm.

Ophion arctiæ MS., Riley and Howard, Insect Life, III, p. 155....1890.
" " MS., Lintner, Seventh Rept. N. Y. State Ent., p. 228 ....1891.
Eremotylus arctiæ Ashmead, Trans. Amer. Ent. Soc., Vol. 23, p. 192, ♀ ♂, Orig. descr ....1896.
" " Morgan, La. Expt. Sta., Bull. 48 (Ser. 2), p. 159 (*Ophion macrurum*)....1897.
" " Ashmead, Smith's Ins. N. J., p. 580....1900.
" " Dalla Torre, Cat. Hym., III, p. 184....1901.
" " Morgan, U. S. Office Expt. Sta., Bull. 99, p. 183, pl. 3, fig. *C*....1901.
Enemotylus " Eliot and Soule, Caterpillars and their Moths, p. 57 ....1902.
Eremotylus " Felt, N. Y. State Mus., Bull. 76, Nineteenth Rept. State Ent., p. 105....1904.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 36, n. 8 ....1905.
" " Viereck, Smith's Ins. N J., p. 620....1910.

Fulvo-ferruginous; wings hyaline; radial vein slender at base, thickened beyond, not flexed; discocubital vein arcuate, its outer two-thirds nearly parallel with the subdiscoidal vein, outer half of third discoidal cell not enlarged, a large irregular glabrous area present in the discocubital cell.

Length, 12–28 mm.; wing, 12–21 mm.; spread, 26–44 mm.; antennæ, 10–25 mm.

Head fulvo-ferruginous or frequently flavous; vertex flavous; ocelli large, prominent, well separated, black, each frequently with an outer ring of flavous; eyes black, emarginate; antennæ long, filiform, fulvo-ferruginous, with a small indistinct median tubercle below and between the antennal fossæ; clypeal foveæ distinct; maxillæ bidentate, tipped with black.

Thorax opaque; mesonotum smooth, with indistinct parapsidal furrows converging towards the scutellum; scutellum convex, hollowed in front and connecting with the mesonotum by lateral keels; metathorax flattened behind, slightly hollowed above the insertion of the abdomen; with an anterior transverse carina, in front of which it is smooth, behind wrinkled; with a weak median longitudinal furrow and several arcuate carinæ originating at the insertion of the abdomen.

Wings hyaline; radial vein slender at base, thickened beyond, not flexed; discocubital vein arcuate, the outer two-thirds nearly parallel with the subdiscoidal vein; third discoidal cell of nearly equal width throughout; discocubital cell with a large irregular glabrous area; nervulus well antefurcal to interstitial; nervellus broken well above the middle; legs of the general color or frequently lighter; claws pectin-

ate; abdomen fulvo-ferruginous, sometimes almost fuscous, strongly compressed.

Redescribed from type and numerous specimens of both sexes.

Type.—♀. No. 3296, U. S. National Museum.

The questionable stability and reasons for restricting the species are discussed under *E. macrurus* L. The existence of light specimens of *macrurus* with hyaline wings has led to considerable confusion. A large series of specimens shows at once that *macrurus* is quite variable in such characters as color, venation and size. The hyaline wings and arcuate shape of the discocubital vein in *arctiæ* seem to be well fixed, and for this reason I have retained the species, drawing the limits closer. Breeding experiments may perhaps show that *arctiæ* is only a subspecies of *macrurus*.

Distribution.—This species ranges through southern Canada, the United States and northern Mexico, from Ottawa, Canada, and Amherst, Mass., to Georgia, Mississippi and California. It appears to have a more limited range than *E. macrurus*, being more restricted to the southern United States. Owing to confusion with the latter, and the present narrowing of the species, many of the records are uncertain, but it has been reported from the following places: Ottawa, Can.; Amherst, Mass.; Vineland, N. J.; Pennsylvania; Washington, D. C.; Tennessee; Jackson, S. C.; Mississippi; Selma, Ala.; Santa Cruz Mountains and Alameda County, Cal. I have seen specimens from the following locations: Harrisburg, Pa.; Tennessee; Tifton, Ga.; Thomasville, Ala., February 12, and Dallas, Tex., April 8; Baldwin and Onaga, Kans.; Indiana; Los Angeles and Stanford University, Cal.

Life history and habits.—Little is recorded of the life history of this species, but so far as known it agrees with that of *E. macrurus*. It preys for the most part on some of the arctians, though it has been reared from saturnians. The cocoon of one specimen from California shows that the parasite spun up and pupated within the body of its host, *Halisidota agassizii*, but this habit is probably variable. In this

case the host evidently died before it could spin up, for the cocoon filled the body cavity and stretched the skin tightly. The imago is of medium size, hence the cocoons may be considered fairly typical, though they will be found to vary somewhat in size. The cocoon is elongate-oval in shape, 16 mm. long and 17 mm. broad, made of dirty-gray silk.

Economic importance.—This species is known to be parasitic upon a number of arctians and saturnians, but its real value can not be estimated since the reports are brief and scattered.

Hosts.

Attacus bolinæ. Specimens in United States National Museum.

Automeris (*Saturnia*) *io* Fabr. Ashmead, Trans. Amer. Ent. Soc., Vol. 23, p. 192, Vineland, N. J.

Callosamia promethea Drury. Felt, N. Y. State Mus., Bull. 76, p. 105.

Diacrisia (*Arctia*) *virginica* Fabr. Ashmead (Jackson, Miss.), Trans. Amer. Ent. Soc., Vol. 23, p. 192.

Ecpantheria deflorata (*scribonia*) Fabr. Riley and Howard, Ins. Life, III, p. 155, Columbia, S. C.

Halisidota agassizii Pack. Specimen from Los Angeles, Cal., in U. S. National Museum.

Isia (*Pyrrharctia*) *isabella* Abb. and Sm. Riley and Howard, Ins. Life, III, p. 155, Thomasville, Ga.

Eremotylus macrurus (Linn.).

(Plate II, fig. 10.)

Ichneumon macrurus Linné., Syst. Nat., ed. 12, Vol. I, pt. 2, app.....1767.
" " Drury, Illustr. Nat. Hist., I, pp. 97, 132, pl. 43, fig. 5.....1770.
" " Ph. L. Müller, Linné.; Vollst. Natursyst. Suppl., p. 319, n. 54.....1776.
" *luteus americanus* Christ, Nat. Syst. Ins. Hym., p. 358, pl. 27, fig. 5.....1791.
Ophion glabratus Say, Boston Journ. Nat. Hist., I, p. 239 (Le Conte ed., II, p. 695). Type lost.....1835.
" *macrurus* Westwood, Drury's Illustr. Nat. Hist., ed. 2, I, p. 92, pl. 43, fig. 5.....1837.
" *rugosus* Brullé, Hist. Nat. Ins. Hym., IV, p. 138, n. 1.....1846.
" *macrurum* Emmons, Nat. Hist. N. Y., V, p. 196, pl. 27, fig. 6.....1854.
" *glabratus* Cresson, Proc. Ent. Soc. Phila., I, p. 206 .....1862.
" " Norton, Idem, p. 358.....1863.

Ophion cecropiæ Scudder, Bost. Soc. Nat. Hist., IX, p. 188.....1863.
" *macrurum* Norton, Proc. Ent. Soc. Phila., I, p, 359, n. 6..1863.
" *cecropiæ* Sanborn, Tenth Ann. Rept. Mass. State Bd. Agr., p. 169.....1863.
" *macrurum* Trouvelot, Amer. Nat., I, p. 89, fig. 1.....1868.
" *macrurus* Smith, Trans. Ent. Soc. London (3) VI, Proc., p. 32.....1868.
" *macrurum* Packard, Guide to Study of Ins., p. 195, fig. 27.....1869.
" " Riley, Amer. Ent., II, p. 100, figs. 63, 64.....1870.
" " Chambers, Idem, p. 156.....1870.
" " Cresson, Trans. Ent. Soc. Phila., IV, p. 169, Texas .....1872.
" " Riley, Fourth Ann. Rept. Ins. Mo., p. 107, figs. 37, 38.....1872.
" *mexicanus* Cresson, Proc. Acad. Nat. Sci. Phila., p. 374...1873.
" *macrurum* Saunders, Fifth Rept. Ent. Soc. Ontario, p. 25, figs. 20–21.....1874.
" " Cresson, Geol. and Geog. Surv. Terr. Rept. Zool., V, p. 708.....1875.
" " Saunders, Sixth Rept. Ent. Soc. Ontario, p. 42, fig. 29.....1875.
" " Worthington, Can. Ent., VIII, p. 220, October..1876.
" " " Idem, IX, p. 60.....1877.
" " French, Seventh Rept. Ins. Ill, p. 194.....1878.
" " Provancher, Nat. Can., XI, p. 117.....1879.
" " Riley, Amer. Ent., III, p. 134, fig. 52.....1880.
" " Packard, Half Hour Rec. in Nat. Hist., p. 220, fig. 170.....1881.
" " Saunders, Can. Ent., XIV, p. 43, fig. 7.....1882.
" " Clarkson, Can. Ent., XV, p. 162.....1883.
" " Saunders, Ins. Inj. to Fruits, pp. 78, 175, 212, figs. 73, 74 (ed. 2, 1889; ed. 3, 1900).....1883.
" " Provancher, Faun. Ent. Can., II, p. 350, n. 1, ♀ ♂ .....1883.
" " Comstock, Kingsley's Stand. Nat. Hist., II, p. 515, fig. 643.....1884.
" " Weed, Papilio, IV, p. 112.....1884.
" " Waterhouse, Trans. Ent. Soc. Lond., Proc., p. XXIII.....1887.
" " Packard, Entomology for Beginners, p. 168. fig. 213.....1888.
" " Fallou, Ann. Ent. Soc. France, IX, Bull., pp. 132, 151 .....1889.
" " Coquillett, Ins. Life, I, p. 286.....1889.
" " Webster, Ins. Life, II, p. 383.....1890.

Ophion macrurum Ashmead, Colo. Biol. Assn. Bull., I, p. 43.....1890.
" " Riley and Howard, Ins. Life, III, p. 154, host list.....1890.
" *glabratum* Riley and Howard, Idem, p. 155, parasitic on *Hyphantria cunea*.....1890.
" *macrurum* Bruner, Nebr. Agr. Exp. Sta., Bull. 14, pp. 14, 15, figs. 4, 5.....1890.
" " Perkins, Eleventh Rept. Vt. State Bd. Agr., p. 196, fig. 36.....1890.
" " Ashmead, Smith's Cat. Ins. N. J., p. 25.....1890.
" *glabratum* Ashmead, Idem, p. 25.....1890.
" *macrurum* Lintner, Seventh Rept. Ins. N. Y., p. 228.....1891.
" " Harrington, Twenty-first Rept. Ent. Soc. Ont., p. 67, fig. 31.....1891.
" " Osborn, Part. Cat. Anim. Iowa, p. 151.....1892.
" " Riley, U. S. Nat. Mus., Bull. 39, Part F, fig. 61.....1893.
" " Webster, Ohio Exp. Sta., Bull. 45, p. 172, figs. 8, 9.....1893.
" " Smith, Rept. N. J. Exp. Sta., p. 582, fig. 167..1893.
" " Fyles, Twenty-fifth Rept. Ent. Soc. Ont., p. 55, fig. 38, transformations within host (Saturnidæ).....1894.
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Orphion " Morgan, La. Agr. Exp. Sta., Bull. 48 (Ser. 2), p. 159, fig. bred from *Artace punctistriga*.....1897.
Ophion " Ashmead, Smith's Ins. N. J., p. 580, fig. 273..1900.
" *marcrurus* Dalla Torre, Cat. Hym., III, p. 194.....1901.
Eremotylus druryi Kriechbaumer, Zeitschr. Syst. Hym. Dipt., I, p. 152.....1901.
Enemotylus macrurus Eliot and Soule, Caterpillars and their Moths, p. 57.....1902.
Eremotylus " Felt, N. Y. State Mus., Bull. 76 (Nineteenth Rept. State Ent.), pp. 100–107, pl. 2, fig. 6, life hist., hosts, etc.....1904.
Ophion macrurum Howard, Insect Book, Plate IX, fig. 8.....1904.
Allocamptus macrurus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 36, n. 5.....1905.
" *druyi* Szepligeti, Idem, p. 36, n. 9.....1905.
Eremotylus macrurus Brues, Journ. Econ. Ent., I, p. 124.....1908.
" *macrurum* Smith, Journ. Econ. Ent., I, p. 295.....1908.
Ophion macrurum Fiske and Thompson, Journ. Econ. Ent., II, p. 453.....1909.

Fulvo-ferruginous; wings more or less tinged with fulvous; radial vein with base thickened and flexed; discocubital vein slightly sinuous; outer half of third discoidal cell enlarged.

Length, 22–38 mm.; wing, 15–27 mm.; spread, 32–57 mm.; antennæ, 18–33 mm.

Fulvo-ferruginous, varied to light flavous, clothed with fine, short pubescence; face, vertex and occiput frequently flavous; eyes large, black, emarginate; ocelli prominent, black, with an outer ring of flavous; antennæ long, slender; face with a more or less distinct median carina running from the anterior ocellus to or below the antennal fossæ; in one specimen forked at both ends but generally simple and often indistinct; mandibles bidentate, tipped with black.

Thorax of the general color, opaque, finely and densely punctured; mesonotum smooth, sometimes with three longitudinal fuscous stripes; parapsidal furrows shallow; scutellum prominent, convex, hollowed in front, with more or less distinct lateral keels. Metathorax flattened behind, its anterior, transverse carina irregular in shape, nearly straight, angularly bent or sinuous, often notched in the middle; the surface in front is smooth, behind irregularly rugose, with a shallow, more or less distinct median furrow, and several arcuate carinæ originating about the insertion of the abdomen; sides of metathorax reticulate.

Wings generally more or less tinged with fulvous, sometimes hyaline; nervulus well antefurcal to interstitial; nervellus broken well below the middle; radial vein thickened at the base and sinuate, with a *small* glabrous area below its base in the discocubital cell; discocubital vein slightly sinuate, the outer half of the third discoidal cell noticeably wider; first recurrent shorter, sometimes much shorter than the second; legs of the general color or somewhat lighter; claws pectinate; abdomen fulvo-ferruginous, sometimes more or less fuscous and darker toward the apex, strongly compressed.

In redescribing this species I have examined over a hundred specimens from all parts of the country.

Type.—Location unknown.

E. macrurus shows considerable variation in coloration of the body and wings, shape of the radial vein and anterior transverse metathoracic carina, number of frenal hooks, size, etc. Most specimens taken north of Mexico have wings more or less tinged with fulvous, while in the majority of Mexican specimens I have seen they are hyaline. Some specimens, however, taken even as far north as Ottawa, Canada, though otherwise characteristic *macrurus*, have hyaline wings. The existence of specimens varying in this way

has led to considerable confusion with *E. arctiæ* Ashm. Dr. Ashmead gave with the original description of *arctiæ* a number of characters which he thought separated *macrurus* and *arctiæ*, but a good series of both shows that many of these are not constant. I have before me a series of *macrurus* showing a complete gradation from a condition where the wings are entirely fulvous to one where they are completely hyaline. In this gradation the fulvous tinge seems to be most permanent at the base of the wing, the clearing beginning at the apex and working towards the body. The number of frenal hooks varies from 7 to 15 and even with the same individual. The type of *arctiæ* has 9 frenal hooks on one side and 11 on the other, and similar variation is common. Too much weight has been laid upon the number of frenal hooks, which, as is thus shown, varies widely. Variation in the form of the anterior transverse metathoracic carina has already been noted in the description. Two characters are, however, apparently quite constant and contrasting in *macrurus* and *arctiæ;* in the former the outer half of the third discoidal cell is markedly widened and the discocubital vein therefore somewhat sinuous; in the latter this cell is of nearly equal width throughout and the discocubital vein is evenly arcuate, its outer half—along the third discoidel cell, nearly parallel with the subdiscoidal nervure. In *arctiæ* the radial vein is narrowed at the base and thickened beyond, while in *macrurus* it is evidently thickened to the stigma. I have seen no specimens of *arctiæ* with this characteristic venation which showed any trace of fulvous in the wings. Some writers have included the smaller specimens —which I place in *macrurus*—with hyaline wings, in *arctiæ*, but they have characteristic *macrurus* venation and the other characters are not constant, as is shown by a series of these specimens. If these are not included in *macrurus*, *arctiæ* Ashm. can not be considered more than a weak subspecies. This question can not be settled absolutely until breeding experiments have been made, but for the present it seems wise to retain *arctiæ* in a restricted sense. There is little doubt that *Ophion glabratus* Say is a synonym of *macrurus*, but since Say's type is lost this can not be abso-

lutely proven. However, several of the smaller specimens of *macrurus* with hyaline wings answer Say's description in all respects. *E. druryi* Kriechbaumer is, in all probability, also a synonym of *macrurus* as comparison of the description with specimens shows; the wings and dark reddish color of the body point unmistakably to *macrurus*, and the fact that the specimens were taken well within the range of *macrurus* (New York) confirms this belief. The very name given by Christ, "The American Yellowbeak," suggests *macrurus*. If any such species, differing from *macrurus*, existed in the State of New York, it would certainly appear in some of the American collections. The fact that the specimens of *E. druryi* were bred from *Platysamia prometheas*, *Samia cynthia* and *Telea polyphemus* adds to the certainty.

I was greatly surprised to find that *Ophion mexicanus* Cresson, which has been placed in the Genus *Enicospilus*, is apparently a synonym of *macrurus*. The hyaline membranaceous spots which Cresson mentions in the discocubital cell are only colorless thickenings which appear frequently in *E. macrurus* and can not be called maculæ. After careful examination of this type I can not consider *mexicanus* even a subspecies of *macrurus*. The specimens which Cameron figures and partially describes as *mexicanus* are evidently some other species belonging in the Genus *Enicospilus*. Cresson described *mexicanus* as follows:

"Female. Large, luteous yellow, shining, clothed with a very short, pale pubescence; head pale, mandibles and palpi tinged with fulvous, tips of mandibles dusky; eyes large, pale; ocelli very prominent, whitish; antennæ as long as the body, dusky fuscous thorax; opaque; mesothorax flattened, with three subobsolete longitudinal fulvous stripes; scutellum yellow; metathorax obliquely flattened posteriorly with coarse arcuate and oblique striæ and a transverse sinuate carina near the base; tegulæ pale; wings hyaline, nervures fulvous, inner radial nerve incrassate towards the stigma and recurved, membranaceous spots in first submarginal cell hyaline, consisting of a cuneiform spot and beneath it a narrow curved line, broadly dilated towards the apex of the wing; legs slender, femora darker in color than the remainder; abdomen tinged with brown, first segment slender, slightly and gradually dilated at the apex.

"Length, 1 inch."

Distribution.—This species has a wide range from Ottawa, Canada, over the whole United States from Maine to California and Florida, more or less of Mexico, Trinidad, and probably other of the West Indian Islands.

Life history and habits.—This species, commonly known as "the long-tailed Ophion," and well represented in most collections throughout the United States, is the largest American member of the genus. It is an active diurnal insect rarely if ever attracted to light. Adults have been taken from March 2 to October 18, but the majority appear during April, May and June. The egg-laying habits and life history have already been treated so far as known. It is often referred to as a parasite and frequently bred from the larger saturnians and arctians. Eight or ten eggs are often laid externally on a caterpillar, but as there is only food enough for one, all but the strongest die in the struggle. As the host spins a stout cocoon the larva of *macrurus* does not need to look for further protection and spins up or sometimes simply pupates within the cocoon of its host. The cocoon when spun is tough, oval, about 32 mm. long by 17 mm. broad, and occupies the greater part of that spun by the host. The silk is fastened together by a dark secretion giving the outside a dark brown color, but with a faint yellowish or gold band around the middle. The interior is thinly lined with a transparent substance giving a bright metallic luster. The mature larva normally hibernates in the cocoon and the adults usually emerge in the spring, but occasionally individuals appear in the autumn.

Economic importance.—*E. macrurus* is without doubt the most important member of this genus, being quite abundant and always fatal to its host. Dr. Weed records an instance were thirty out of fifty pupæ of *Samia columbia* Sm. were parasitized by this insect, and in another two-thirds the pupæ of *Callosamia promethea* were affected, while Fiske and Thompson report that it affected 32.7 per cent. of Promethea, 7.3 per cent. of Cecropia and 10 per cent. of Polyphemus. Its value as a parasite is somewhat modified by the fact already mentioned that "the larvæ often fail to make proper pupæ, due probably to some disease which reaches

them within the body of the host." This does not prevent the parasite from killing the host but checks its own increase. Investigations at the Gypsy Moth Laboratory show that when the host is attacked by more than one parasite, *macrurus* is frequently the subject of secondary parasitism.

Hosts.

Apatelodes torrefacta Sm., Virginia. Riley, Ins. Life, III, p. 154...1890.
Artace punctistriga Walk. Morgan, La. Exp. Sta., Bull. 48, p. 159.....1897.
Automeris io Fabr. Felt, Nineteenth Rept. N. Y. St. Ent., p. 102.....1904.
Callosamia promethea Dr. Webster, Ins. Life, II, p. 383; Felt, Nineteenth Rept. N. Y. St. Ent., p. 103; Fiske and Thompson, Journ. Econ. Ent., II, p. 453.
Hyphantria cunea Dr. Riley and Howard, Idem, III, p. 155 (*O. glabratum*) .....1890.
Samia columbia Sm. Felt, Nineteenth Rept. N. Y. St. Ent., p. 102.....1904.
Telea polyphemus Cram., March 8; May 8.
Philosamia cynthia Dr., March 8.
Isia isabella, Abb. and Sm., March 8.
Samia cecropia L., October 2.

Location of specimens.—Specimens will probably be found in most collections in the United States, but certainly in the following: American Entomological Society, Pennsylvania, February 9; Michigan; Texas; Florida; Mexico; Rhode Island; Illinois. Boston Society of Natural History. New York. Leland Stanford, Jr., University, Cal., June 2 and June 9. Massachusetts State College, Massachusetts; New Hampshire; Mexico. Museum of Comparative Zoology, Pennsylvania; Texas. Minnesota State College, Minnesota; Maryland. Munich Entomological Museum, New York, September 15. North Carolina State College, North Carolina. New Hampshire State College, New Hampshire, May 13. Rutgers College, New Jersey. New York State Museum, Albany, N. Y. Pennsylvania State Museum, Pennsylvania, April 12 and 19, May 16 and 25, September 13; New York. U. S. National Museum, Washington, D. C.; Florida; Arkansas; Indiana; Cordoba, V. C. Mexico, January 24, 1908.

Eremotylus texanus (Ashm.).

Plate III, fig. 16.

Thyreodon texanus Ashmead, Proc. U. S. Nat. Mus., Vol. 12, p. 422, ♂.....1890.
" " Trans. Amer. Ent. Soc., Vol. 23, p. 193.....1896.
" " Dalla Torre, Cat. Hym., III, p. 186.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 25, n. 22.....1905.

Ferruginous; wings fuliginous to fuscous; body especially frequently marked with black; nervulus antefurcal; nervellus broken below the middle.

Length, 20–33 mm.; wing, 15–22 mm.; spread, 33–47 mm.; antennæ, 20–30 mm.

Ferruginous, varied with black and fulvous; head impunctate or finely punctured, clothed with fine, short, white pubescence, longer on the labrum; vertex of the general color—in one specimen black—eyes and ocelli black or dark brown; eyes emarginate, medium to small, distant from the base of the mandibles, clypeal foveæ deep; mandibles bidentate, tipped with black.

Thorax ferruginous to fulvo-ferruginous, shining, densely but finely punctured and clothed with fine, short pubescence; mesonotum with parapsidæ indistinct or lacking; scutellum deeply excavated in front, connected with the mesonotum by lateral carinæ; metathorax gradually sloping and slightly flattened behind, with median furrow and shallow arcuate carinæ originating about the insertion of the abdomen; a lateral carina at the edge of the posterior area bordered with a reticulate band; spiracles large, linear, surrounded by a groove.

Wings light to dark fuliginous, somewhat lighter towards the apex; stigma flavous; nervures fuscous, nervulus antefurcal to interstitial, nervellus broken below the middle; radial vein slightly sinuate, a small glabrous area below its base in the discocubital cell; discocubital vein unevenly arcuate; the outer half of the third discoidal cell enlarged; legs fulvo-ferruginous, claws pectinate; abdomen of the general color, often varied with black beyond the first segment; in one specimen almost entirely black beyond the second; in another this color occupies the ventral half of the fourth and succeeding, while in the third the ventral half of the abdomen beyond the first segment is of this color.

In redescribing this species I have examined the type and eight specimens.

Type.—♀. No. 2053, U. S. National Museum, Texas.

A good species, easily separated from other members of this genus by the more or less distinctly fuliginous wings.

It was originally described by Ashmead as a *Thyreodon*, but he was not sure where it belonged as shown by his statement, after the description, that "the large stigma might exclude it from the genus *Thyreodon*." Later (Transactions American Entomological Society, Vol. 23) he states that *T. texanus* belongs to the genus *Eremotylus*. The general character, especially the shape of the radial and discocubital veins, the nervellus broken well below the middle and the presence of a stigma place it at once in the genus *Eremotylus*. It has been confused with *Ophion slossonæ*, but these two species can be easily distinguished by their venation which is typical of the two genera. It is apparently closely related to *E. infuscatus*.

Distribution.—Cypress Mills, Texas; Moscow Mountains, Idaho, July 8; Washington.

This species seems to have a somewhat limited range in the southern and western United States and northern Mexico. It has been taken at Cypress Mills, Texas; California; Moscow Mountains, Idaho, and Washington.

Nothing is known of the life history, habits or hosts of this species.

Location of specimens.—U. S. National Museum, type ♂, No. 2053, Texas; cotype ♂, Cypress Mills, Tex. American Entomological Society, homotype, western Texas; ♂, California. American Museum of Natural History, two ♂ homotypes, Moscow Mountains, Idaho, July 8. Massachusetts Agricultural College, homotype, ♀.

Eremotylus infuscatus (Tasch.).

Ophion infuscatus Taschenberg, Zeitschr. f. d. Ges. Natur., Vol. 46, p. 429, n. 11.....1875.
" " Dalla Torre, Cat. Hym., III, p. 192, listed....1901.
Eremotylus infuscatus Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 36, n. 6.....1905.

Testaceous: base and apex of abdomen, occiput, most of the thorax, posterior coxæ and femora, more or less fuscous; ocelli large; wings subhyaline; nervellus broken far above the middle; discocubital vein arcuate, not appendiculate, inner part of the radius bent and thickened.

Length, 23 mm.

Testaceous; head, basal fourth of the antennæ and a part of the vertex joining the dark complex of the large ocelli, brown; occiput more or less fuscous; thorax almost entirely brown; mesonotum brown, shell-yellow, with three broad, confluent, fuscous stripes of which the lateral ones are noticeably shorter in front; prosternum brown on a yellow background; mesopleuræ, pleuræ and metathorax fuscous; metathorax with an anterior transverse carina, confluent at the sides with a lateral carina; the area in front of the transverse carina is smooth, that behind rugose.

Wings subhyaline, with fuscous nervures; base of radius thickened and bent; discocubital vein arcuate, not appendiculate; nervellus broken far above the middle; legs testaceous, the front pair light, while on the posterior ones only the coxæ and femora are browned and the apex of the tibiæ is marked above with little black spots.

Abdomen with the dorsum of the first three segments browned; the first only on the apical hlaf, the third all except the apex; the fourth is shell-yellow throughout while the two following are browned throughout; the segments beyond this unfortunately are missing.

Type.—Location unknown.

I have not seen a specimen of this species, and can only give a free translation of the original description with such additions as can be gathered from Kriechbaumer's keys. It is apparently closely related to *E. texanus*, which may prove to be synonymous.

Distribution.—Brazil?

MISPLACED AND UNRECOGNIZED SPECIES, Etc.

Ophion analis Say.

Ophion analis Say, Contrib. Maclur. Lyc. Phila., II, p. 75, n. 2, ♀ ..1828.
" " Say, Writ. Th. Say, Le Conte ed., I, p. 379, n. 2...1859.
Anamalon analis Norton, Proc. Ent. Soc. Phila., I, p. 361, n. 14, ♀ .....1863.
" *anale* Provancher, Nat. Can., XI, p. 143, n. 4, ♀ ♂.....1879.
" " " Faun. Ent. Can., Hym., p. 357, n. 4, ♀ ♂..... .....1883.
" " Dalla Torre, Cat. Hym., III, p. 162.....1901.

This species was placed in the Genus *Anomalon* by Norton, and his action has been accepted by all later writers.

? **Ophion atrata** Fabr. (D. T.).

Ichneumon atratus Fabricius, Spec. Ins., I, p. 436, n. 98.....1781.
" " " Ent. Syst., II, p. 179, n. 191.....1793.
Ophion " " Syst. Piez., p. 132, n. 5 .....1804.

Pimpla atrata Dalman, Svensk. Vet. Akad. Handl., 46, p. 188, pl. 1.....1825.
Rhyssa " Brullé, Hist. Nat. Ins., Hym., IV, p. 77, n. 1, pl. 40, f. 1.....1846.
Thalessa " Provancher, Nat. Can., XII, p. 13, n. 1.....1880.
Megarhyssa atrata Dalla Torre, Cat. Hym., III, p. 479, Canada; United States.....1901.

This species is common throughout the United States and recognized as belonging to the Genus *Megarhyssa*.

Ophion brachiator Say.

Ophion brachiator Say, Boston Journ. Nat. Hist., I, p. 240, n. 5..1835.
" " Le Conte, Writ. Th. Say, Entom., II, p. 695....1859.
" " Dalla Torre, Cat. Hym., III, p. 188, America, Indiana .....1905.

"*Black; abdomen and feet yellowish; a petiolated second cubital cellule.*

"Length, nine-twentieths of an inch.

"Antennæ, first joint beneath, white; mandibles whitish, piceous at the tip; palpi white; wings hyaline; stigma slender, blackish; second cubital cellule rather large, quadrangular, more or less petiolated from the radial cellule; anterior recurrent nervure a little arcuate, not angulated and with a white bulla; second recurrent nervure rectilinear, with a white bulla; metathorax with an impressed longitudinal line and a transverse raised one at base; abdomen honey-yellow; first joint white at base, second joint blackish above; feet, posterior pair honey-yellow, tarsi blackish; intermediate pair white, with honey-yellow thighs; anterior pair white."

Say adds: "I place this in the Genus *Ophion* because of the compressed falcate abdomen, notwithstanding the existence of the second cubital cellule." The species evidently does not belong in this genus, nor even in this tribe.

Distribution.—Indiana.

Ophion chloris Oliv.

Ophion chloris Olivier, Encycl. Meth., Ins., VIII, p. 509, n. 4.....1811.
Paniscus chloris Norton, Proc. Ent. Soc. Phila., I, p. 364, n. 27...1863.

This species is undoubtedly a member of the Genus *Paniscus*, aud Norton states that "There is very little doubt that this is the *O. geminatus* of Say." Dalla Torre, however, preserves both species.

Ophion clathratus Br.

Ophion clathratus Brullé, Hist. Nat. Ins., Hym., IV, p. 137, n. 5.....1846.
" " Dalla Torre, Cat. Hym., III, p. 188.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 94.....1905.

Luteous; antennæ nearly red; thorax with three dorsal fuscous stripes; metathorax with base smooth; apex reticulate

Length, 32 mm.

It is yellow, with antennæ red and the back of the metathorax ornamented with three broad indistinct brown lines. The metathorax is divided into two very unequal parts; the first is smooth with the posterior edge projecting and nearly straight; the second is uniformly flattened, bordered laterally by a projecting line (carina ?) or sort of pad and surmounted by some very distinct oblique pads, of which the first two rise longitudinally on the middle. The abdomen is missing beyond the second segment.

Type.—Location unknown.

Undoubtedly an *Ophion*, but the description is too incomplete for specific recognition.

Distribution.—Guiana.

Ophion dentator Fabr.

Ophion dentator Fabricius, Syst. Piez., p. 138, n. 36.....1904.
" " Olivier, Encycl. Meth., Ins., VIII, p. 515, n. 45...1811.
Ichneumon dentator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 272.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 341.....1824.
Ophion dentator Dalla Torre, Cat. Hym., III, p. 189, Amer. mer..1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 96.....1905.

Thorax black, varied with flavous; abdomen banded; posterior femora one-toothed.

Habitat.—Amer. Merid.

Small, head flavous; antennæ and vertex black. Thorax flavous and black varied; dorsum (mesonotum) black, with two flavous lines. Abdomen petiolate, falcate, the slender first segment with the base flavous and apex black, the second black; the rest with the base flavous and apex black. Wings short, hyaline; marginal point (stigma) black. Feet flavous; the posterior femora with two black bands and towards the apex an acute projecting tooth.

Type.—Location unknown.

I doubt if the species belongs in this tribe.

Ophion dimidiator Fabr.

Ophion dimidiator Fabricius, Syst. Piez., p. 136, n. 31.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 514, n. 38..1811.
Ichneumon demidator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 262.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 314.....1824.
Ophion dimidiator Dalla Torre, Cat. Hym., III, p. 189, Amer. Mer.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 97.....1905.

Flavous; antennæ black; abdomen fuscous; base flavous.

Habitat.—Amer. Merid.

Structure and size of *O. luteus;* head flavous; vertex black; antennæ black; thorax flavous, immaculate. Abdomen petiolate, falcate, compressed, the first and second segments ferruginous, the rest blackish. Feet flavous.

This description is too incomplete to make identification possible.

Ophion emarginatus Say.

Ophion emarginatus Say, Bost. Journ. Nat. Hist., I, 3, p. 245, n. 8; Comp. Wrs., II, p. 699 (1859).....1836.
Anomalon emarginatum Dalla Torre, Cat. Hym., III, p. 164.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 13, n. 82.....1905.

This species has for some time been recognized as belonging to the Genus *Anomalon.*

Ophion extenuator Fabr.

Ophion extenuator Fabricius, Syst. Piez., p. 137, n. 35.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 514, n. 44..1811.
Ichneumon extenuator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 265.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 321.....1824.
Ophion extenuator Dalla Torre, Cat. Hym., III, p. 190, Amer. Mer.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 98.....1905.

Black; abdomen falcate, rufous; dorsum black, the anterior feet ferruginous.

Habitat.—Amer. Merid.

Structure entirely like *O. pugillator* but three times as small, and slender. Antennæ porrect, black, Head black, mouth whitish. Thorax immaculate black; abdomen slender, falcate, incrassate behind, red, with dorsum black; ovipositor exserted the length of the abdomen, with a shorter double sheath. Wings short, white; feet ferruginous.

The length of the ovipositor, "extending the length of the abdomen," seems to place this in a genus outside this tribe.

Ophion flavidus Br.

Ophion flavidus Brullé, Hist. Nat. Ins. Hym., IV, p. 143, n. 12....1846.
" " Dalla Torre, Cat. Hym., III, p. 190.....1901.
" " Szepligeti, Gen. Ins., Hym., 34meFasc., p. 31, n. 99.....1905.

Flavid, with abdomen and base of antennæ rufous; scutellum flavous; metathorax with two arcuate lines.

Length, 20 mm.

It is yellowish, with the antennæ, feet and underside of the abdomen reddish-yellow. The largest part of the abdomen is brown, especially below, and the edge of the segments. The face is more or less reddish in the middle; the head and scutellum are in general yellow. The mesothorax shows three more or less distinct brown lines. The nervures of the wings are brown, the stigma is yellow, the median vein (discocubital) is twice bent, the first angle is more or less prolonged on the inside. The metathorax little or not at all rugose, showing a shallow longitudinal groove in the second region, and a slightly arched, projecting carina more or less interrupted in the middle, running parallel to the edge of the first region. This line is a little stronger in the middle and on the sides.

Type.—Location unknown.

This description seems to contain no distinctive characters.

Distribution.—Brazil.

Ophion flavorufus Br.

Ophion flavo-rufus Brullé, Hist. Nat. Ins. Hym., IV, p. 144.....1846.
" *flavorufus* Dalla Torre, Cat. Hym., III, p. 191.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 102.....1905.

Ferruginous; head and scutellum flavous, face ferruginous; metathorax rugose, bilineate.

Length, 20 mm.

It is reddish ferruginous, with the head and scutellum sulphur-yellow and the face reddish ferruginous. The abdomen is brown, on the lower edges of the segments yellowish; the wings have brown nervures, the stigma part red and part brown; the median nervure (discocubital) biangular and the discoidal cell longer than high. The metathorax is punctured in front, reddish behind; its primary region at the posterior edge emarginate in the middle; oblique on each side in the manner of very open stripes. A more or less complete arched sinuous line crosses the second region.

Type.—Location unknown.

I have not seen a specimen which meets the requirements of this description, and can only give a translation of the original description, for it has not since been mentioned except in catalogue.

Distribution.—Brazil.

Ophion geminatus Say.

Ophion geminatus Say, Contrib. Maclur. Lyc. Phila., II, p. 76, n. 3..1828.
" " " Comp. Writ. Th. Say, Ent., I, p. 379, n. 3..1859.
Paniscus geminatus Norton, Proc. Ent. Soc. Phila., I, p. 364, n. 26.....1863.
" " Cresson, Trans. Amer. Ent. Soc., IV, p. 171, ♀ ♂.....1872.

This species was placed in the Genus *Paniscus* by Norton and his action has been accepted by all writers. It is common throughout the United States and superficially resembles some of the Ophions, but may be readily separated by the presence of an areolet in the anterior wings. Norton states that this species and *chloris* Oliv., 1828, are synonymous, but Dalla Torre preserves both species.

Ophion glaucopterus (Linn.) Fabr.

Ichneumon glaucopterus Linné, Syst. Nat., ed. 10 a, I, p. 566, n. 53.....1758.
" " Linné, Syst. Nat., 12 ed., I, 2, p. 938, n. 57.....1767.
Ophion " Fabricius, Suppl. Ent. Syst., p. 236, n. 4...1798.
" " Olivier, Encycl. Meth., Ins., VIII, p. 510, n. 8.....1811.
" " Gravenhorst, Nova Acta. Acad. Nat. Avios., IX, p. 295.....1828.

Paniscus glaucopterus Gravenhorst, Ichn. Europ., III, p. 633, n. 108.....1829.
Opheltes " Holmgren, Svenk. Vet. Akad. Handl., II, 2, p. 8 (Oph.), p. 30, n. 1.....1858.
Opheletes " Provancher, Faun. Ent. Can., Hym., p. 359, figs. 38, 39.....1883.
Opheltes " Cresson, Syn. Hym. N. Amer., p. 202.....1887.
" " Morley, The Entomologist, XLII, p. 137, ♀..1909.

Habitat.—Amer. bor.; Europe.

This species has long been recognized as a member of the Genus *Opheltes*.

Ophion holosericeus Tasch.

Ophion holosericeus Taschenberg, Zeitschr. Ges. Naturw., 46, p. 427.....1875.
" " Dalla Torre, Cat. Hym., III, p. 192.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 103.....1905.

Sericeous, rufous; scutellum flavous; apex of abdomen darker.

Length, 19 mm.

A fine white coat of hair covers the whole body, of which the red ground color is changed by the reflected light of the place; the apex of the abdomen is indistinctly, especially along the lower part, with brown; the scutellum, and also the posterior part of the head is frequently paler (more yellowish). The metanotum bears far forward a transverse carina, angularly broken in the middle, and running from there evenly back; behind this a weak parallel transverse carina, as well as median longitudinal lines which run back from the apex of the angle in the anterior transverse carina and gradually disappear. Below this is also a lateral carina running from the outer end of the stigma to the apex of the thorax, and a lateral boundary to mark the posterior half of the sloping part. From the hinder border of the large cell (discocubital) springs an appendix.

Specimens lying before me differ from the preceding [*O. pallipes*] through a slightly redder color and striking pubescence as well as through a much weaker posterior transverse carina on the metathorax.

I do not recognize this as any species with which I am acquainted.

Type.—Location unknown.

Distribution.—Parana, Brazil.

Ophion intricatus Br.

Ophion intricatus Brullé, Hist. Nat. Ins. Hym., IV, p. 143, n. 13...1846.
" " Dalla Torre, Cat. Hym., III, p. 192.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 31, n. 104.....1905.

Rufous; face and scutellum flavous; metathorax with confused lines. Length, 20 mm.

It resembles the preceding—*O. flavidus*—except that the first line of the metathorax, on the edge of the first region, is strongly emarginated in the middle; the space between this border and the lesser line of the second region is divided into three parts by two raised lines; this lesser line is angulate, and the part nearest is surmounted by two longitudinal approaching lines. The second region of the metathorax is rugose. Finally, the discoidal cell is longer than broad while it is scarcely longer than broad in the preceding—*O. flavidus*.

This description is not sufficiently definite.

Type.—Location unknown.

Distribution.—Chile.

Ophion luteus (Linn.) Fabr.

Ichneumon luteus Linné, Sys Nat., ed. 10a, I, p. 566, n. 51.....1758.
" " Fabricius, Syst. Ent., p. 341, n. 75 .....1775.
" " *americana*, Christ, Natur. d. Ins., p. 359, pl. 37, fig. 5, Amer.....1791.
Ophion " Fabricius, Suppl. Ent. Syst., p. 235, n. 1.....1768.
" " Gravenhorst, Ichneumon. Europ., III, p. 692, n. 136, ♀ ♂.....1828.
" " Curtis, Brit. Ent., XIII, p. 600, n. 1.....1836.
" " Spinola, Gay's Hist. fis. y. pol. Chile, Zool., VI, p. 516, n. 2, Chile .....1851.
" " Taschenberg, Zeitschr. f. d. Ges. Naturw., 46, p. 426, n. 6, Amer.....1875.
Ophion luteus Bridgman and Fitch, Entomologist, XVII, p. 179, n. 2.1884.
" " Phillipi, Festschr. Ver. Natur. zu. Cassel, pp. 17, 20, Chile (?).....1886.
" " Riley and Howard, Insect Life, I, p. 155.....1888.
" " Thomson, Opusc. Ent., Pt. 12, p. 1190. n. 1.....1888.
" " Brauns, Arch. Naturg. Mechlenburg, 43, p. 90, n. 4..1889.
" " Dalla Torre,* Cat. Hym., III, p. 193.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 30, n. 28..1905.
" " Schmiedeknecht, Opusc. Ichn., XIX, p. 1441.....1908.

This species is found throughout Europe.

* Only a part of the extensive bibliography is given here, but all American references and the best European are included; the rest will be found in Dalla Torre, Cat. Hym., III, p. 193, 1901.

Ophion merdarius Grav.

Ophion merdarius Taschenberg, Zeits. f. d. Ges. Nat., 46, p. 435, n. 22.....1875.
" " Wheeler, Psyche, VI, p. 545.....1893.

Taschenberg records this species, now placed in the Genus *Enicospilus*, from Illinois (North America), and Rosario (South America) taken from *Saturnia cecropia*. This is a well-known Old World species and the determination was probably a mistake.

Ophion mundus Say.

Ophion mundus Say, Bost. Journ. Nat. Hist., I, 3, p. 239, n. 3.....1836.
Anomalon flavipes Brullé, Hist. Nat. Ins. Hym., IV, p. 170, n. 1, ♀ ♂ .....1846.
Ophion mundus Say, Compl. Writ. Th. Say. II, p. 695, n. 3.....1859.
Exochilum mundus Norton, Proc. Ent. Soc. Phila., p. 360, n. 10...1863.
" " Cresson, Proc. Acad. Nat. Sci. Phila., p. 375, n. 1.....1873.

This species was placed in the Genus *Exochilum* by Norton, and his action has been accepted by all later writers.

Ophion nigrator Fabr.

Ophion nigrator Fabricius, Syst. Piez., p. 140, n. 46.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 517, n. 56...1811.
Ichneumon planator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 259.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 307.....1824.
Ophion nigrator Dalla Torre, Cat. Hym., III, p. 196, Amer. Mer..1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 106.....1905.

Flavous; antennæ black; wings fuscous.

Habitat.—Amer. Merid.

Small; head flavous; antennæ, three ocelli and vertex, black; thorax rather flat, flavous, immaculate. Abdomen long, petiolate; apex compressed, flavous, shining; ovipositor short, incurved. Wings fuscous, feet flavous.

This description is too brief to be distinctive.

Ophion obscurus Fabr.

Taschenberg* records this species from Illinois, North America, and Mendoza, South America. It is a well-known Old World species, and as no other record of its capture exists it is probably due to an erroneous determination.

* Zeits. f. d. Ges. Naturw., 46, p. 426, n. 5, 1875.

Ophion pallipes Br.

Ophion pallipes Brullé, Hist. Nat. Ins. Hym., IV, p. 144, n. 15..1846.
" " Taschenberg, Zeitschr. f. d. Ges. Naturw., 12, p. 427, n. 7.....1875.
" *pallidipes* Dalla Torre, Cat. Hym., III, p. 197 .....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 107 .....1905.

Dark ferruginous, tibiæ and tarsi red, wings flavid; base of metathorax hollowed out.

Length, 20 mm.

It is dark ferruginous with the legs and tarsi yellowish-red, and the segments of the abdomen bordered with black from the third. The hooks of the tarsi are black; the trochanters and trochantines yellowish-red; the wings are washed with yellow, with the nervures brown and the stigma yellowish-red; the median discocubital nervure is nearly biangular with an internal prolongation; the discoidal cellule is nearly as broad as long.

The lobes of the mesothorax are distinct, a little raised and slightly canaliculate. The metathorax is surmounted by two slightly sinuous projecting lines (carinæ) which divide it into three regions, of which the first is strongly excavated at the base with a longitudinal furrow, the second divided into three parts by two parallel, longitudinal lines, the third and last slightly longitudinally wrinkled. The first region alone is distinctly punctured.

Type.—Location unknown.

This description seems to lack the distinctive characters necessary for its recognition.

Distribution.—Brazil (Prov. des Mines).

Ophion pennator Fabr.

Ophion pennator Fabricius, Syst. Piez., p. 135, n. 24.....1804.
" " Olivier, Encycl. Meth., Ins., VII, p. 513, n. 30...1811.
Ichneumon pellator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 262 .....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 314.....1824.
" *pennator* Cresson, Trans. Amer. Ent. Soc., VI, p. 209..1877.
Ophion " Dalla Torre, Cat. Hym., III, p. 197, Amer., Georgia.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 118.....1905.

Rufous; head and anus black, wings fuscous.

Habitat.—Amer. Merid.

In structure and size entirely like *O. pugillator;* head with antennæ black; thorax fuscous, immaculate. Abdomen compressed, falcate; apex truncate, black; ovipositor short, exserted. Wings fuscous, with two small hyaline spots in the anterior part.

Olivier gives a similar description, but Mr. E. T. Cresson believes that it "is probably *Trogus exesorius* Br."

Ophion quadrator Fabr.

Ophion quadrator Fabricius, Syst. Piez., p. 137, n. 32.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 514, n. 39..1811.
Ichneumon quadrator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 262.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 315.....1824.
Ophion " Dalla Torre, Cat. Hym., III, p. 198, Amer. Mer.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 108.....1905.

Flavous; second abdominal segment black, apex of wings black.

Habitat.—Amer. Merid.

Smaller than the preceding, *O. dimidiator.* Head flavous; antennæ black, the first segment flavous. Thorax immaculate flavous.

Abdomen petiolate, falcate, slender; the first segment obscure ferruginous, the second black, the third black above, the rest flavous.

Wings hyaline, apex black; feet flavous, the posterior black.

This description is too indefinite to make recognition possible.

Ophion quæstor Fabr.

Ophion quæstor Fabricius, Syst. Piez., p. 132, n. 6.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 510, n. 10....1811.
Ichneumon quæstor Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 259.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 307.....1824.
Ophion " Dalla Torre, Cat. Hym., III, p. 198, Amer. Mer.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 109.....1905.

Flavous; thorax with three oval raised fuscous tubercles.

Habitat.—Amer. Merid.

A little smaller than *luteus.* Head flavous; antennæ darker, the first segment flavous; thorax flavous, with three anterior, raised, oval fuscous tubercles; abdomen petiolate, falcate, flavous, apex trun-

cate; dark, the exserted ovipositor very short; wings hyaline; feet flavous.

This description is too incomplete to make recognition possible.

Ophion relictus Fabr.

Ophion relictus Fabricius, Ent. Syst. Suppl., p. 236, n. 5.....1798.
" " " Syst. Piez., p. 133, n. 12.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 511, n. 18....1811.
Ichneumon relictus Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 262.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 314.....1824.
Anomalon " Norton, Proc. Ent. Soc. Phila., I, p. 360, n. 13, ♀ ♂.....1863.
" *relictum* Provancher, Nat. Can., XI, p. 143, n. 3, fig. 5, ♀ ♂.....1879.
" " Provancher, Faun. Ent. Can., Hym., p. 357, n. 3, fig. 37.....1883.
" " Dalla Torre, Cat. Hym., III, p. 169.....1901.

This species was placed in the Genus *Anomalon* by Norton, and his action has been accepted by all later writers.

Ophion spinator Fabr.

Ophion spinator Fabricius, Syst. Piez, p. 138, n. 37.....1804.
" " Olivier, Encycl. Meth., Ins., VIII, p. 515, n. 46...1811.
Ichneumon spinator Thunberg, Bull. Acad. Sci. St. Petersbourg, VIII, p. 262.....1822.
" " Thunberg, Mém. Acad. Sci. St. Petersbourg, IX, p. 313.....1824.
Ophion " Dalla Torre, Cat. Hym., III, p. 199, Amer. Merid.....1901.
" " Szepligeti, Gen. Ins., Hym., 34me Fasc., p. 32, n. 111.....1905.

Posterior of the thorax and base of the abdomen black, posterior femora one-toothed

Habitat.—Amer. Merid.

Smaller than the preceding (*O. dentator*), head dark red, antennæ black; thorax red in front, black behind; abdomen petiolate, falcate, the first and second segments black, the rest red; ovipositor exserted, black. Wings white, with a black marginal spot. Feet rufous, the posterior femora with a small acute tooth.

I fail to recognize this description as that of any Ophion I have seen.

Ophion undulatus Grav.

Taschenberg* records this species, now placed in the Genus *Allocamptus*, from Brazil, and North America, taken from *Saturnia* (*Samia*) *cecropia*. It is a well-known Old World species, and as no other record of its capture in America exists, the determination was probably erroneous.

* Zeitsch. f. d. Ges. Naturw., 46, p. 430, n. 12, 1875.

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EXPLANATION OF PLATES.

The figures on the following plates were prepared by the author as camera lucida drawings, and lack of bilateral symmetry is therefore due to the angle at which the object was viewed.

PLATE I.

FIG.
1. Side view of thorax of *Ophion bilineatus*.
a. prothorax.
a1. collar.
a2. lateral projection.
ab. insertion of abdomen.
ac. anterior coxa.
b. mesothorax.
b1. mesonotum.
b2. mesopleuron.
b3. transverse furrow.
b4. scutellum.
c. metathorax (proper).
c1. postscutellum.
c2. metapleuron.
c3. metathoracic epimeron.
d. median segment or metathorax (of descriptions).
h. insertion of head.
mc. median coxa.
pc. posterior coxa.
t. tegula.

FIG.
2. Abdomen of *Ophion bilineatus* (female).
1–7. abdominal plates.
ce. cerci.
o. ovipositor.
s. sheath.

FIG.
3. Dorsal view of thorax of *Ophion bilineatus*.
a. prothorax.
a1. collar.
a2. lateral projection.
ab. insertion of abdomen.
aw. anterior wing.
b. mesothorax.
b1. mesonotum.
b2. mesopleuron.
b3. transverse furrow.
b4. scutellum.
c. metathorax (proper).
c1. postscutellum.
c2. metapleuron.
c3. metathoracic epimeron.
d. metathorax (of descriptions) or median segment, showing three transverse carinæ.
h. insertion of head.
pc. posterior coxa.
pw. posterior wing.
t. tegula.

FIG.
4. Front view of head of *O. bilineatus*.
af. antennal fossa.
cf. clypeal foveæ.
cl. clypeus.
e. eyes.
m. mandibles.
oc. ocelli.
v. vertex.

FIG.
5. Apex of abdomen of *O. bilineatus* (male).
4–7. abdominal plates.
ce. cerci.
cla. claspers.
p. penis.

FIG.
6. Cocoon of *Enicospilus purgatus*.
op. opening.
l. lid.

FIG.
7. Cleaning apparatus.
ti. tibia.
tic. tibial comb.
ta. first tarsal segment.
tac. tarsal comb.

Plate II.

FIG.

8. Wings of *O. bilineatus*. Veins and cells named according to Cresson.

Veins :

a. anal.
ap. appendix.
b. basal.
c. costal.
cu. cubital.
d. discoidal.
dc. discocubital.
fh. frenal hooks.
m. median.
np. nervus parallelus (of Szepligeti).
pm. posterior margin.
r. radial or marginal.
r1. basal half of radial or marginal.
r2. apical half of radial or marginal.
re 1. first recurrent.
re 2. second recurrent.

FIG.

s. stigma.
sc. subcostal.
sd. subdiscoidal.
sm. submedian.
tc. transverse cubital.
tm 1. transverse median or nervulus.
tm 2. transverse median or nervellus.

Cells :

1. median or costal.
2. submedian.
3. anal.
4. discoidal.
5. second discoidal.
6. third discoidal.
7. radial or marginal.
8. submarginal or cubital.
9. second apical.
10. first apical.
11. first discoidal.
12. second discoidal.

FIG.

9. Anterior wing of *Thyreodon cyaneus*.
10. Posterior wing of *Eremotylus macrurus*.
n, abmormal vein.
11. Front view of head of *Ophion abnormis magniceps*.
12. Anterior wing of *Enicospilus concolor*.
13. Anterior wing of *Eremotylus angulatus*.

FIG.

Plate III.

14. Anterior wing of *Enicospilus cubensis*.
15. Anterior wing of *Ophion abnormis* (with abnormal appendix).
16. Anterior wing of *Eremotylus texanus*.
17. Wings of *Ophiopterus ferrugineus*.
18. Metathorax (median segment) of *Ophiopterus ferrugineus*.
19. Anterior wing of *Enicospilus purgatus*.
20. Anterior wing of *Ophion abnormis magniceps*.
21. Cocoon of *Thyreodon morio*.
l, exit opening.
22. Anterior wing of *Enicospilus thoracicus*.
23. Anterior wing of *Enicospilus purgatus arcuatus*.
24. Anterior wing of *Enicospilus flavus*.

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EXPLANATORY NOTE.

On account of the length of the following paper, it has been found necessary to publish it in *two* parts. All the plates will appear at the end of the second part in Volume XXXIX, and to prevent confusion with plates of other papers in Volume XXXVIII, only the figure numbers (which are consecutive), are given in the text of the first part.

THE BOMBIDÆ OF THE NEW WORLD.

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INTRODUCTION.

In June, 1908, a synopsis of the American species of *Bombus* and *Psithyrus* north of the northern boundary of Mexico was presented by the writer as part of a thesis for the degree of Doctor of Philosophy. Since that time the work on these two genera has been extended to take in all the New World species at present known. The work as a whole has, for the most part, been done under the supervision of Doctors Charles H. and Henry T. Fernald, and the writer here wishes to acknowledge his obligations and express his gratitude to these able teachers and investigators for their aid, guidance and encouragement.

This monograph is based upon the examination and careful study of about fifteen thousand North American and one thousand South American specimens, comprising the entire bumble-bee collections of the Massachusetts Agricultural College, New Hampshire College, Montana Agricultural College, Museum of Comparative Zoölogy, Leland Stanford Jr. University, Agricultural College of the University of Minnesota, United States National Museum, American Museum of Natural History, Boston Society of Natural History, also the entire Pennsylvania State collection and the greater part of the collections of the American Entomological Society, the North Carolina Agricultural College and the Colorado Agricultural College, besides several private collections.

The writer is deeply indebted to many persons for assistance rendered in various ways. Some have loaned literature and provided scattering references. Others, through the kindness of the Doctors Fernald in assuming responsibility for loaned specimens, have loaned material for study. For such favors the writer wishes to thank very heartily the fol-

lowing gentlemen: Messrs. J, C. Crawford, H. L. Viereck, E. T. Cresson, Sr., Wm. Beutenmüller, J. C. Bridwell, and E. Daecke, Prof. T. D. A. Cockerell, Prof. R. A. Cooley, Prof. C. W. Johnson, Judge P. G. Bolster of Boston, Dr. Heinrich Friese of Germany, Prof. H. A. Surface, Prof. Franklin Sherman, Jr., Prof. V. L. Kellogg, Prof. E. S. G. Titus, Prof. C. P. Gillette and Prof. E. D. Sanderson. Gratitude is hereby also expressed to Dr. Henry Skinner for the privilege of studying the types and other material in the collection of the American Entomological Society, to Mr. Samuel Henshaw for the privilege of examining the bumble-bee collection of the Museum of Comparative Zoölogy and for assistance with literature, to Dr. L. O. Howard for the privilege of studying the types in the collection of the United States National Museum and for the loan of the rest of the bumble-bee material in that Museum, to Prof. C. P. Lounsbury of Cape Colony for gathering information concerning the growing and seeding of red clover in South Africa, and to Prof. W. W. Froggatt of New South Wales for information concerning the growing and seeding of red clover in Australia, and concerning the attempted introduction of bumble-bees into that country. Indebtedness to the three following gentlemen, who, since this aid was given, have closed their earthly labors, is also acknowledged: Dr. James Fletcher and Dr. W. H. Ashmead for the loan of specimens, and Colonel C. T. Bingham for information concerning the types deposited in the British Museum.

Practically all of the types of species described by the New World workers on this group have been seen and carefully examined by the writer, and considerable effort has also been put forth to gain more definite knowledge concerning the types of New World species which have been described by European workers and deposited in European museums.

The bibliographies of the genera and subgenera have been made as full and complete as any future worker on the group will probably wish to have them, and no pains have been spared to make the bibliography of every species included in this paper absolutely complete. The writer has himself

read nearly every reference included in these bibliographies, and the few which he has been unable to see are marked with asterisks. References which have been seen and are placed with doubt are marked with an interrogation point.

A large amount of information has been collected which it is impossible to include in this paper because the pressure of other work does not, at present, allow time to put it into shape for publication. The writer intends, however, to later prepare and publish another paper on the New World Bombidæ which may be looked upon as a supplement to the present work. That paper will probably deal principally with methods of collecting nests, with the life histories, habits and natural enemies of the two genera and with the phylogeny of the family and of its groups and species as shown by palæontology, by comparative morphology and by distribution.

It is hoped that future workers on this family will go slow in describing new North American species for, if such species exist, they are certainly very few. It should be borne in mind that the bumble-bees are conspicuous insects, and that the North American species have received much attention from entomologists. In this conuection, the fact should be noticed that most of the recently described species of this continent are not, in the writer's opinion, valid. To specify, none af Ashmead's species and only one of Cockerell's and one of Morrill's are so considered in this monograph, and moreover, out of about eleven species captured north of the northern boundary of Mexico and described as new, either heretofore or in this work by the writer himself, only three can be considered as being valid and distinct beyond question. South and Central America should, however, be more productive of new forms and, in both continents, there is need of much investigation concerning the distribution and nesting habits of the various speceies, and it is hoped that this paper will give an impetus to such studies.

The writer has experienced much difficulty in describing the colors exhibited by the pile of the various species, and future workers on the group, when using this paper, must make allowance for this.

History of Bombidæ.

All the older Hymenopterists included the species of *Bombus* and *Psithyrus* in the great genus *Apis*, and they were retained there until after Kirby and a few others had noted the peculiar habits of *Bombus* and had published descriptions of the principal characters in which they differ from *Apis* and other bee genera, and had in entomological literature called them Bombinatrices. In 1802, Latreille established the genus *Bombus* to include indiscriminately both the true bumble-bees and the guest bumble-bees. William Kirby (in 1802) was the first to observe the more noticeable structural differences between the females of the true bumble-bees and of their inquilines, but he did not know anything of the habits of the latter. Illiger in 1806, followed by Dahlbom in 1832, made a second division of the bumble-bees to contain the species the females of which were without corbiculæ. Lepeletier, in 1832, made a genus of this division, giving it the name *Psithyrus*, and in the same paper indicated a parasitic or inquilinous habit for the species to be placed in it. Two years later, Newman, probably in ignorance of the fact that a name had already been given, gave the genus the name *Apathus*. These two names have both been much used by later workers on this family, and it is only comparatively recently that the name *Psithyrus* has become firmly established and constantly used. Moreover, some authors continued to place these species in *Bombus* for many years after the name *Psithyrus* was given. Greene placed them in *Bombus* in 1860 and Gerstäecker did likewise as late as 1869. Frederick Smith used the name *Apathus*, as he considered that *Psithyrus* had been preoccupied by Hübner in 1816 for a genus of Lepidoptera. Hübner, however, did not use the name *Psithyrus*, his spelling having been "*Psithyros*." Touching on this close similarity of names, the International Code of Zoölogical Nomenclature, in its recommendations under Article 36, says, "It is well to avoid the introduction of new generic names which differ from generic names already in use only in termination or in a slight variation in spelling which might lead to confusion. But when once introduced such names are not to be

rejected on this account." *Psithyrus* must, therefore, be used as the correct name for the genus of "guest bumblebees."

This family of bees, the genus *Bombus* especially, has probably received more attention from entomologists than has any other, the Apidæ excepted. This has been due, for the most part, to a certain conspicuousness caused by size and abundance. Their social habits have also induced much special study. Among the more prominent European workers on the classification of the family, the following may be particularly mentioned: Fabricius, Latreille, Kirby, Dahlbom, Lepeletier, Illiger, Nylander, Schenck, Thomson, Smith, Gerstäecker, Morawitz, Kriechbaumer, Schmiedeknecht, Radoszkowski, Handlirsch and Friese. The work of Schmiedeknecht has been of especial importance, as he was the first to really bring order out of chaos among the European species which had become badly mixed up principally on account of an even more remarkable variation of color characters than that exhibited by the American species in general. In America the pioneer work of Cresson has been the most important and the most accurate of all. Several other American workers have, however, contributed much of value. Among these may be mentioned Provancher, Greene, Cockerell, Ashmead, Viereck, Robertson, Titus, Crawford, Swenk and Morrill. Of American workers, Putnam, Cresson and Packard have published considerable of value on the habits of the Bombidæ, but the most important work along this line has been done by Europeans, among whom we may particularly mention Hoffer, Hüber and Reaumur of the older writers, and Schmiedeknecht, Friese, Wagner and Buttel-Reepen of those more recent.

Several attempts have been made to divide the genus *Bombus* up into natural groups or sections and to indicate to some extent the relationship of its species. Except the work of General O. Radoszkowski and of Robertson, along this line, all such attempts have, up to this time, been but little better than guesswork. All, except Radoszkowski and Robertson, have based their conclusions concerning relation-

ship very largely on coloration and similarity of general appearance. A knowledge of the great color variation shown by many species of this group should be enough to condemn coloration as a basis for determining relationships with certainty. It is probable that those who have depended on coloration in such classifications have, in most cases at least, been compelled to depend on that or nothing because of lack of material, especially of males, for dissection. It is particularly desirable to know the characters of the male genitalia in judging relationships, but other structural characters should be considered in connection with them. In this paper, the work of Radoszkowski has been followed as far as possible, in the naming of the natural groups and also, for the most part, in the naming of the accessory male genital organs. Unfortunately, Robertson's division of the genus into *Bombus* and *Bombias* is not likely to stand the test of critical study for reasons given in another place.

THE FAMILY BOMBIDÆ.

Bombinatrices Kirby, Mon. Ap. Angl., I, 1802, p. 200 and II, p. 317.

Bombides Lepeletier, Hist. Nat. Insect, I, 1836, p. 436 and *Psithyrides* Lepeletier, ibid, II, 1841, p. 423.

Bombidæ Greene, Ann. Lyc. Nat. Hist. N. Y., 1862, p. 168.

Bombina Thomson, Opusc. Ent., I, 1869, pp. 7 and 11.

Bombidæ Schmiedeknecht, Apidæ Europaeæ 1882–1884 (pp. 11_* and 13_* and 263) and *Psithyridæ* Schmiedeknecht, ibid (p. 12_* and 14_* and 390).

Bombinæ Friese, Die Bienen Europa's (Apidæ Europaeæ) nach ihren Gattungen, 1895–1897 and *Psithyrinæ* Friese, ibid.

" Dalla Torre, Cat. Hym., X, 1896, p. 503, and *Psithyrinæ* Dalla Torre, ibid, p. 565.

Bombidæ Ashmead, Proc. U. S. N. M., XXIII, 1901, p. 191 and *Psithyridæ* Ashmead, ibid, p. 192.

" Ashmead, Trans. Amer. Ent. Soc., XXVI, 1899, pp. 54 and 57, and *Psithyridæ* Ashmead, ibid, pp. 54 and 58.

Bombinæ Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 176.

Bombidæ Viereck, Trans. Amer. Ent. Soc., XXIX, 1902, p. 44 and *Psithyridæ* Viereck, ibid, p. 45.

Bombinæ Schmiedeknecht, Hym. Mitteleurop., 1907, p. 22, and *Psithyridæ* Schmiedeknecht, ibid., p. 23.

Bombidæ Viereck, Trans. Amer. Ent. Soc., XXXII, 1906, pp. 224, 238, 240, 242, 245.

Bombidæ Lovell, Ent. News, XVIII, 1907, p. 196.
" Swenk, Ent. News, XVIII, 1907, p. 294.
" Cockerell, Ann. and Magaz. Nat. Hist., Ser. 8, Vol. II, 1908, pp. 325 and 326.

Dalla Torre, in his "Catalogus Hymenopterorum," classifies the bees or Anthophila (flower pollenizers) under fourteen subfamilies of the great family Apidæ. This arrangement is the same as that proposed by Friese, and is, in most respects, similar to the one previously proposed by Schmiedeknecht and to the one followed later by Ashmead, except that Schmiedeknecht and Ashmead placed the family Apidæ (in the large sense) in the position of a superfamily, and made the subdivisions to rank as families. In Friese's and Dalla Torre's arrangement, the genus *Bombus* was placed in the subfamily Bombinæ and the genus *Psithyrus* in the distinct subfamily Psithyrinæ (established by Shenck in 1859). Lepeletier considered *Bombus* as belonging to a family distinct from *Psithyrus*. Greene described species of *Bombus* and *Psithyrus* indiscriminately as *Bombus*. Schmiedeknecht, in his earlier work, and Ashmead looked upon *Bombus* and *Psithyrus* as belonging to separate families of coördinate rank with the other families of the Apoidea as recognized by them—Bombidæ and Psithyridæ. Robertson placed *Bombus* and *Psithyrus* together in the subfamily Bombinæ. Schmiedeknecht, in his last comprehensive work on the Hymenoptera, placed *Bombus* and *Psithyrus* in the separate and distinct subfamilies, Bombinæ and Psithyrinæ of the great family Apidæ. Viereck, followed later by Lovell, Swenk and Cockerell, placed *Bombus* and *Psithyrus* together in the family Bombidæ, but did not apparently recognize them as forming separate groups of subfamily rank. After careful study of the characters of the two genera and a comparative study of the characters and relationships of other bee genera, I am convinced that Viereck's arrangement, of all those thus far published, most nearly expresses the true relatiouship of the two genera, and that we must look upon them as being simply two comparatively closely related genera of the family Bombidæ, if we are to adopt Ashmead's general classification of

the Hymenoptera into superfamilies. I do not consider that they should be given even separate subfamily rank.

May I here cite the relationship of two other genera, as expressed in Dalla Torre's and Ashmead's classification, in support of my belief that *Bombus* and *Psithyrus* should be placed in the same family? Both Friese and Dalla Torre placed the genera *Melipona* and *Apis* together in the subfamily Apinæ, and Ashmead included them both in the family Apidæ (in the restricted sense). To be sure, in their habits the species of *Melipona* are more like those of *Apis* than those of *Psithyrus* appear to be like those of *Bombus*, but *Psithyrus* is structurally far more like *Bombus* than is *Melipona* like *Apis*.

Centris and *Eucera* are evidently, from their structure, much less closely related than are *Bombus* and *Psithyrus*, yet Ashmead did not consider it necessary to place them in separate groups of subfamily rank in the family Anthophoridæ, neither did Dalla Torre place them in separate subfamilies of the great family Apidæ. I might cite numerous other examples showing the inconsistency in placing *Bombus* and *Psithyrus* either in separate families or in separate subfamilies. Those who have so placed them have evidently been led to do so by the general differences in habit between the two genera rather than by structural differences.

Characters on the Bombidæ.

The family Bombidæ, as extended to include *Psithyrus*, may be briefly described as follows:

Medium to large, robust bees with oblong bodies and a rather dense covering of hair. Head subtriangular. Antennæ geniculated, filiform, longer than the head. Ocelli placed in a slight curve on the vertex. Malar space (except in some males) ample. Clypeus not carinate. The tongue long and slender, reaching considerably beyond the propodeum when fully extended; the labial palpi four segmented and the maxillary palpi normally two segmented. Labrum transverse. Mandibles of female stout, and grooved exteriorly towards their apex; those of the male two-toothed and heavily bearded exteriorly on their lower sides. Front wings large (these insects are capable of long and rapid flight) with the marignal cell as long as the three cubital cells united. The first cubital cell nearly divided by a distinct (rarely indistinct) but delicate, oblique streak or nervure; the second cubital

cell much narrowed towards the marginal, receiving the first recurrent nervure about the middle; the third cubital narrowed towards the marginal, receiving the second recurrent nervure near its apex. Scutellum semicircular, rounded off posteriorly and not projecting strongly over the median segment. Hind metatarsi of the female more or less strongly dilated, Hind tibiæ with two apical spurs. Claws bifid. Abdomen robust in form, truncate at base and convex above, pointed at apex in females and rounded in males. The females provided with a strong sting.

Tables of Genera.

Females.

Hind tibiæ convex and well covered with hair without; each side of the apical portion of the hypopygium with a noticeable elevation or carina.....**Psithyrus.**

Hind tibiæ flat or concave and, for the most part, bare on their outer sides, their fore and hind borders fringed with long hairs forming pollen baskets; apical ventral abdominal segment without lateral elevations.....**Bombus.**

Males.

Volsella and squama of genitalia membranous; face always densely covered with black pile with which there is usually no admixture of yellow hairs; outer surface of hind tibiæ, in most species, well covered with pile throughout.....**Psithyrus.**

Volsella and squama of genitalia corneus; a good share of the species with face bearing a noticeable amount of yellow pile; outer surface of hind tibiæ in most species more or less bare.
Bombus.

Genus **BOMBUS** Latreille.

Apis Linnæus and other authors (in part).
Bombus Latreille, Hist. Nat. Crust. and Insect, III, 1802, p. 385 (in part).
" Latreille, Hist, Nat. Fourmis, 1802, p. 436 (in part).
" Fabricius, Syst. Piez., 1804, p. 342 (in part).
Bremus Panzer, Fauna Insect. German. VIII, 1805 (in part).
Bombus Illiger, Magaz. f. Insektenk., V, 1806, p. 158 (in part).
Bremus Jurine, Nouv. meth. class. Hymen. 1807, p. 259 (in part).
Bombus Leach, Brewster Edinb. Encycl., 1815, 4, Vol. 9, p. 1.
" Dahlbom, Bombi Scandin., 1832, p. 23, Div. I.
" Lepeletier, Ann. Soc. Ent. France, I, 1832, p. 366..
" Westwood, Intr. Mod. Class. Insect. II, 1840, p. 280.
" Smith, Cat. Bees of Great Britain, 1855, p. 207.

Bombus Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1862, p. 168 (in part).
" Cresson, Proc. Ent. Soc. Phil., III, 1863, p. 83.
" Thomson, Opusc. Ent., I, 1869, pp. 7 and 12.
" Schmiedeknecht, Apidæ Europeæ, 1882–1884, p. 263.
" Provancher, Faun. Ent. Can., II, 1883, pp. 728 and 733.
" Friese, Die Bienen Europas (Apidæ Europaeæ), 1895–97.
" Ashmead, Trans. Amer. Ent. Soc., XXVI, 1899, p. 57.
" Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 176.
" Schmiedeknecht, Hym. Mitteleurop., 1907, p. 24.

Type of genus.—*Bombus terrestris* (L.), established by Latreille when he described the genus.

Common names.—Species of both *Bombus* and *Psithyrus* are commonly known as "Humble-bees" or "Bumble-bees" in England. They are also sometimes called "Dumbledors" in portions of that country. In the United States they are everywhere known as "Bumble-bees." These names are all somewhat similar, and were originally given to these insects on account of the humming sound they make in flight. The German name "Hummel" and the French "Bourdon" have similar origins.

Geographical Distribution.

Species of *Bombus* are present on all the great land areas of the globe, except Australia. Prof. W. W. Froggatt, Government Entomologist for New South Wales, after giving, in a letter written in 1910, a brief account of the various introductions of *B. terristris* into that colony, states that all these introductions appear to have been unsuccessful. He also states that he does not "think there is a live bumble-bee in Australia."

In Africa these insects are confined entirely to the mountainous region north of the Sahara Desert, there being three or four species in Algeria and Morocco. The great deserts stretching across this continent appear to form as effective a barrier against the southward distribution of bumble-bees as would the great oceans themselves.

On the remaining continents, however, Bombi are widely distributed and appear to be present everywhere, except

where lakes or deserts or very arctic climates make existence for them impossible.

Oceanic islands are often entirely without Bombi in the tropics of the Western Hemisphere, even when lying comparatively near the mainland. In this connection we may note that the temperate zone, Aleutian and Pribilof Islands, though scattering far out to sea, are supplied with bumble-bees, while Cuba, Haiti, Porto Rico, and probably most of the other West Indian Islands do not have them at all. It is doubtful. however, if the Falkland Islands have bumble-bees. Most European and Oriental islands, whether temperate or tropical, if not at a prohibitive distance from the mainland, have more or less Bombi. We may note in support of this that Bombi have been recorded with certainty from the following islands.

1. Oriental: Japan (numerous species), Formosa, Philippines, Sumatra, Java,
2. European: Great Britain (many species), Ireland, Madiera, Canary, Sardinia, Corsica, Sicily.

The islands lying near the continent of Australia have, of course, no bumble-bees, except where they have been introtroduced by man (New Zealand).

In tropical regions of the Western Hemisphere, even at the equator, the genus *Bombus* has adapted itself to all altitudes, from sea-level well up toward the snow line of the lofty mountains. In this connection, the following records from close to sea-level are interesting: *B. niger* n. sp. and *B. brevivillus* n. sp. from Pernambuco, Brazil; *B. emiliæ* D. T. from Bahia, Brazil; *B. incarum* n. sp. from Georgetown, British Guiana; *Psithyrus brasiliensis* Smith from Para, Brazil. The following records from the Andes are the highest New World altitudes, and possibly also the highest world altitudes from which bumble-bees have ever been reported: *B. opifex* from Tara, Argentina (4,000 meters altitude) and *B. coccineus* from Cuzco, Peru (13,600 feet altitude). Still higher altitudes of capture may some time be reported from the Andes and also from the Plateau of Thibet or its surrounding mountain chains, but in all other parts of the

world (Popocatapetl and Orizaba excepted) these records would be above the snow line and so pass the limits of bumble-bee habitation.

In the New World and in Asia also *Bombus* ranges from the Equator (2° North Latitude in Asia, if Sumatra is not included) to well within the Arctic Circle. The farthest north records of capture are the following: *B. kirbyellus* Curt. from Port Foulke (78¼° North Latitude) and *B. polaris* Curt. from McCormick Bay (77° North Latitude), Greenland.

In South America, *B. dahlbomii* Guer. reaches the Straits of Magellan and is abundant there. It will probably also be found in Tierra del Fuego. No other species, however, appears to be present so far south. The next most southern species, *B. emiliæ* Dalla Torre, has, as yet, not been recorded south of Juarez, Argentina (about 38° South Latitude), though, as it has been reported as very abundant at Tandil, only about eighty miles northeast of Jaurez, it probably ranges to a considerable distance south of that place. However, our records, as a whole, indicate a paucity of species of *Bombus* in the southern part of this continent as no species, besides *dahlbomii* and *emiliæ*, has been reported south of Buenos Aires.

The New World species of *Bombus* and *Psithyrus*, as they occur in the various political divisions, are listed below. Gaps in the known habitat have, in this list, been filled in, as far as they reasonably could be, according to the author's judgment of the unknown habitat based on the known. The known habitat of each species is given after the specific description. Extensive collecting will doubtless, in many cases, extend considerably the geographical range as at present known or conjectured. Hence this listing must be looked upon as only approximately correct. However, it is probably accurate enough to give a pretty good idea of the general distribution of the two genera and of their various groups and to indicate, in some measure, what have been the main factors in influencing this distribution.

Political Division	Number of Species	Genera	Groups	Species
Alaska	16	Bombus	Auricomus	nevadensis.
			Dumoucheli	californicus.
			Kirbyellus	kirbyellus, stenuus.
			Terrestris	occidentalis, terrestris *var.* moderatus.
			Pratorum	alboanalis, edwardsii, flavifrons, frigidus, gelidus, melanopygus, mixtus, pleuralis, sitkensis, sylvicola.
	2	Psithyrus	Fernaldæ	fernaldæ, tricolor.
Yukon	3	Bombus	Terrestris	occidentalis.
			Pratorum	sitkensis, sylvicola.
Mackenzie	3	Bombus	Pratorum	frigidus, melanopygus, sylvicola.
Athabasca	2	Bombus	Pratorum	frigidus, melanopygus.
British Columbia	14	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus.
			Borealis	appositus.
			Dumoucheli	californicus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, frigidus, huntii, melanopygus, mixtus, sitkensis.
	6	Psithyrus	Ashtoni	latitarsus, suckleyi.
			Fernaldæ	fernaldæ, tricolor.
			Laboriosus	consultus, insularis.
Keewatin	7	Bombus	Kirbyellus	arcticus, kirbyellus, polaris.
			Pratorum	frigidus, melanopygus, mixtus, sylvicola.
Alberta	18	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus.
			Borealis	borealis, appositus.
			Dumoucheli	californicus, fervidus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis, terricola.
			Pratorum	edwardsii, flavifrons, frigidus, huntii, melanopygus, mixtus, sitkensis, ternarius, vagans.
	5	Psithyrus	Ashtoni	latitarsus, suckleyi.
			Fernaldæ	tricolor.
			Laboriosus	consultus, insularis.
Saskatchewan	13	Bombus	Fraternus	rufocinctus.
			Borealis	borealis.
			Dumoucheli	californicus, fervidus.
			Kirbyellus	kirbyellus.
			Terrestris	terricola.
			Pratorum	frigidus, huntii, melanopygus, mixtus, sylvicola, ternarius, vagans.

Political Division	Number of Species	Genera	Groups	Species
Saskatchewan (Cont'd.)	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	consultus, insularis.
Manitoba	9	Bombus	Fraternus	rufocinctus.
			Borealis	borealis.
			Dumoucheli	fervidus.
			Terrestris	terricola.
			Pratorum	frigidus, mixtus, perplexus, ternarius, vagans.
	2	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	insularis.
Greenland	3	Bombus	Kirbyellus	kirbyellus, arcticus, polaris.
Labrador	6	Bombus	Kirbyellus	kirbyellus, polaris.
			Pratorum	couperi, frigidus, mixtus, sylvicola.
Newfoundland		Bombus	Borealis	borealis.
	5		Terrestris	terricola.
			Pratorum	bolsteri, couperi, frigidus.
Prince Edward Island	2	Bombus	Terrestris	terricola.
			Pratorum	ternarius.
	2	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	laboriosus.
New Brunswick and Nova Scotia	4	Bombus	Borealis	borealis.
			Terrestris	terricola.
			Pratorum	ternarius, vagans.
	3	Psithyrus	Ashtoni	ashtoni.
			Fernaldæ	tricolor.
			Laboriosus	laboriosus.
Quebec	13	Bombus	Fraternus	rufocinctus, separatus.
			Borealis	borealis.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	terricola.
			Pratorum	couperi, frigidus, impatiens, mixtus, perplexus, ternarius, vagans.
	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	insularis, laboriosus.
Ontario	16	Bombus	Auricomus	auricomus.
			Fraternus	rufocinctus, separatus.
			Borealis	borealis.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis, terricola.
			Pratorum	bimaculatus, couperi, frigidus, impatiens, mixtus, perplexus, ternarius, vagans.
	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	insularis, laboriosus.
New England	13	Bombus	Auricomus	auricomus.
			Fraternus	rufocinctus, separatus.
			Borealis	borealis.

Political Division	Number of Species	Genera	Groups	Species
New England (Cont'd.)		Bombus (Cont'd.)	Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis, terricola.
			Pratorum	bimaculatus, impatiens, perplexus, ternarius, vagans.
	5	Psithyrus	Ashtoni	ashtoni.
			Fernaldæ	fernaldæ, tricolor.
			Laboriosus	insularis, laboriosus.
New York	13	Bombus	Auricomus	auricomus.
			Fraternus	rufocinctus, separatus.
			Borealis	borealis.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis, terricola.
			Pratorum	bimaculatus, impatiens, perplexus, ternarius, vagans.
	5	Psithyrus	Ashtoni	ashtoni.
			Fernaldæ	fernaldæ, tricolor.
			Laboriosus	insularis, laboriosus.
Pennsylvania	10	Bombus	Auricomus	auricomus.
			Fraternus	separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus, impatiens, perplexus, ternarius, vagans.
	2	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	laboriosus
New Jersey, Delaware and Maryland	11	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus, impatiens, perplexus, vagans (ternarius in Maryland).
	2	Psithyrus	Ashtoni	ashtoni (in part of Maryland).
			Laboriosus	laboriosus.
Virginia and West Virginia	11	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus, impatiens, perplexus, ternarius, vagans.
	2	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	laboriosus.
Michigan	14	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, rufocinctus, separatus.
			Borealis	borealis.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis, terricola.
			Pratorum	bimaculatus, impatiens, perplexus, ternarius, vagans.
	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	laboriosus, insularis,

Political Division	Number of Species	Genera	Groups	Species
Minnesota and Wisconsin	13	Bombus	Auricomus	auricomus.
			Fraternus	rufocinctus, separatus
			Borealis	borealis.
			Dumoucheli	ervidus, pennsylvanicus.
			Terrestris	affinis, terricola.
			Pratorum	bimaculatus, impatiens, perplexus, vagans, ternarius.
	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	insularis, laboriosus.
Iowa, Missouri and Illinois	8	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Pratorum	bimaculatus,impatiens,vagans.
	2	Psithyrus	Laboriosus	laboriosus, variabilis.
Ohio	9	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus,impatiens,vagans.
	1	Psithyrus	Laboriosus	laboriosus.
Indiana	8	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Pratorum	bimaculatus,impatiens,vagans.
	1	Psithyrus	Laboriosus	laboriosus
Kentucky	9	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Pratorum	bimaculatus, impatiens, perplexus, vagans.
	2	Psithyrus	Laboriosus	laboriosus, variabilis.
Tennessee	10	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis (eastern part of State).
			Pratorum	bimaculatus, impatiens, perplexus, vagans.
	2	Psithyrus	Laboriosus	laboriosus, variabilis.
North Carolina	10	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus, impatiens, perplexus, vagans.
	1	Psithyrus	Laboriosus	laboriosus.
South Carolina and Georgia	7	Bombus	Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Terrestris	affinis.
			Pratorum	bimaculatus, impatiens.
	1	Psithyrus	Laboriosus	laboriosus.

Political Division	Number of Species	Genera	Groups	Species
Florida	4	Bombus	Fraternus	fraternus, separatus.
			Dumoucheli	pennsylvanicus.
			Pratorum	mpatiens.
	0	Psithyrus		
Alabama, Louisiana and Mississippi	5	Bombus	Fraternus	fraternus, separatus.
			Dumoucheli	pennsylvanicus.
			Pratorum	bimaculatus, impatiens.
	1	Psithyrus	Laboriosus	variabilis.
Arkansas	6	Bombus	Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Pratorum	bimaculatus, impatiens.
	1	Psithyrus	Laboriosus	variabilis.
North Dakota	8	Bombus	Fraternus	separatus.
			Borealis	borealis.
			Dumoucheli	fervidus.
			Terrestris	terricola.
			Pratorum	huntii, perplexus, ternarius, vagans.
	3	Psithyrus	Ashtoni	ashtoni.
			Laboriosus	insularis, laboriosus.
South Dakota	8	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus, separatus.
			Dumoucheli	fervidus, pennsylvanicus.
			Pratorum	huntii, ternarius, vagans.
	1	Psithyrus	Laboriosus	laboriosus.
Nebraska	14	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, morrisoni, separatus, rufocinctus.
			Dumoucheli	californicus, fervidus, pennsylvanicus.
			Terrestris	occidentalis.
			Pratorum	bimaculatus, centralis, huntii, impatiens, vagans.
	3	Psithyrus	Laboriosus	insularis, laboriosus, variabilis.
Kansas	10	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, rufocinctus, separatus.
			Dumoucheli	californicus, fervidus, pennsylvanicus.
			Pratorum	bimaculatus, impatiens, vagans.
	2	Psithyrus	Laboriosus	laboriosus, variabilis.
Oklahoma	6	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	californicus, fervidus, pennsylvanicus.
	1	Psithyrus	Laboriosus	variabilis.
Texas	6	Bombus	Auricomus	auricomus.
			Fraternus	fraternus, separatus.
			Dumoucheli	fervidus, pennsylvanicus, sonorus.

Political Division	Number of Species	Genera	Groups	Species
Texas (Cont'd.)		Psithyrus	Laboriosus	variabilis.
Washington	18	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	frigidus, huntii, melanopygus, mixtus, sitkensis, ambiguus, centralis, edwardsii, flavifrons, vosnesenskii.
			Ashtoni	latitarsus, suckleyi.
	6	Psithyrus	Fernaldæ	fernaldæ, tricolor.
			Laboriosus	consultus, insularis
Oregon	17	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	ambiguus, centralis, edwardsii, flavifrons, huntii, melanopygus, mixtus, sitkensis, vosnesenskii.
	4	Psithyrus	Ashtoni	suckleyi.
			Laboriosus	consultus, crawfordi, insularis.
California	19	Bombus	Auricomus	nevadensis.
			Fraternus	crotchii, henshawi, morrisoni, rufocinctus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus, sonorus.
			Terrestris	occidentalis.
			Pratorum	ambiguus, centralis, edwardsii, fernaldi, flavifrons, huntii, mixtus, sitkensis, vosnesenskii.
	2	Psithyrus	Ashtoni	suckleyi.
			Laboriosus	crawfordi.
Nevada	13	Bombus	Auricomus	nevadensis.
			Fraternus	morrisoni, rufocinctus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, fernaldi, flavifrons, huntii, vosnesenskii.
	0	Psithyrus		
Idaho	14	Bombus	Auricomus	nevadensis.
			Fraternus	separatus, rufocinctus.

Political Division	Number of Species	Genera	Groups	Species
Idaho (Cont'd.)		Bombus (Cont'd.)	Borealis	appositus.
			Dumoucheli	californicus, fervidus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, frigidus, huntii, mixtus, sitkensis.
	5	Psithyrus	Ashtoni	latitarsus, suckleyi.
			Fernaldæ	tricolor.
			Laboriosus	consultus, insularis.
Montana	17	Bombus	Auricomus	nevadensis.
			Fraternus	rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	fervidus, pennsylvanicus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, frigidus, huntii, melanopygus, mixtus, sitkensis, vagans.
	5	Psithyrus	Ashtoni	latitarsus, suckleyi.
			Fernaldæ	tricolor.
			Laboriosus	consultus, insularis.
Wyoming	18	Bombus	Auricomus	nevadensis.
			Fraternus	fraternus, rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus, pennsylvanicus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, frigidus, huntii, melanopygus, mixtus, vagans, sitkensis.
	4	Psithyrus	Ashtoni	suckleyi.
			Fernaldæ	tricolor.
			Laboriosus	consultus, insularis.
Utah	13	Bombus	Auricomus	nevadensis.
			Fraternus	fraternus, rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, huntii, melanopygus.
	3	Psithyrus	Ashtoni	suckleyi.
			Laboriosus	consultus, insularis.
Arizona	9	Bombus	Auricomus	nevadensis.
			Fraternus	morrisoni, rufocinctus.
			Dumoucheli	californicus, fervidus, sonorus.
			Terrestris	occidentalis.
			Pratorum	centralis, huntii.
	0	Psithyrus		

Political Division	Number of Species	Genera	Groups	Species
Colorado	20	Bombus	Auricomus	auricomus, nevadensis.
			Fraternus	fraternus, morrisoni, rufocinctus, separatus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus, pennsylvanicus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	centralis, edwardsii, flavifrons, frigidus, huntii, melanopygus, mixtus, vagans.
	3	Psithyrus	Fernaldæ	tricolor.
			Laboriosus	consultus, insularis.
New Mexico	17	Bombus	Auricomus	auricomus, nevadensis.
			Fraternus	fraternus, morrisoni, rufocinctus.
			Borealis	appositus.
			Dumoucheli	californicus, fervidus, pennsylvanicus, sonorus.
			Kirbyellus	kirbyellus.
			Terrestris	occidentalis.
			Pratorum	centralis, cockerelli, edwardsii, flavifrons, huntii.
	3	Psithyrus	Laboriosus	bicolor, consultus, insularis.
Mexico	20	Bombus	Fraternus	brachycephalus, crotchii, fraternus, haueri, mexicensis, rubicundus.
			Dumoucheli	dolichocephalus, medius, mexicanus, montezumæ, nigrodorsalis, pennsylvanicus, sonomæ, sonorus, steindachneri.
			Pratorum	ephippiatus, laticinctus, pulcher, trinominatus, vosnesenskii.
	1	Psithyrus	Laboriosus	intrudens.
Central America	13	Bombus	Fraternus	funebris, ramonensis, volucelloides, weisi.
			Dumoucheli	dolicocephalus, guatemalensis, medius, mexicanus, montezumæ, niger, steindachneri.
			Pratorum	ephippiatus, pulcher.
	1	Psithyrus	Laboriosus	guatemalensis.
Colombia	13	Bombus	Fraternus	funebris, robustus, rubicundus, vollucelloides, weisi.
			Dumoucheli	atratus, carolinus, incarum, mexicanus, niger, steindachneri.
			Pratorum	ephippiatus, pulcher.
	0	Psithyrus		

Political Division	Number of Species	Genera	Groups	Species
Venezuela	7	Bombus	Fraternus	robustus, rubicundus.
			Dumoucheli	carolinus, kohli, niger, steindachneri.
			Pratorum	pulcher.
	0	Psithyrus		
The Guianas	1	Bombus	Dumoucheli	incarum.
	0	Psithyrus		
Ecuador	16	Bombus	Fraternus	butteli, ecuadorius, funebris, robustus, rubicundus, vollucelloides, handlirschi.
			Dumoucheli	carolinus, guatemalensis, kohli, medius, mexicanus, niger, pullatus, steindachneri.
			Pratorum	ephippiatus.
	0	Psithyrus		
Peru	13	Bombus	Fraternus	baeri, butteli, coccineus, funebris, handlirschi, robustus, rubicundus, vollucelloides.
			Dumoucheli	carolinus, incarum, kohli, niger, opifex.
	0	Psithyrus		
Bolivia	6	Bombus	Fraternus	baeri, ecuadorius, funebris, robustus, vollucelloides, weisi *var.* albocaudata.
	0	Psithyrus		
Brazil	8	Bombus	Dumoucheli	brasiliensis, brevivillus, dahlbomii, emiliae, incarum, kohli, medius, niger.
	1?	Psithyrus		brasiliensis (doubtful).
Paraguay	6	Bombus	Dumoucheli	atratus, brasiliensis, incarum, kohli, medius, niger.
	0	Psithyrus		
Uruguay	3	Bombus	Dumoucheli	dahlbomii, emiliae, kohli.
Argentina	8	Bombus	Fraternus	baeri, robustus, sulfuratus, tucumanus.
			Dumoucheli	dahlbomii, emiliae, kohli, opifex.
Chili	4	Bombus	Fraternus	baeri, robustus.
			Dumoucheli	dahlbomii, opifex.

In examining carefully this list we note the following peculiarities:

1. A scarcity of species in the following Canadian provinces and territories: Yukon, Mackenzie, Athabasca, Keewatin, Manitoba, Labrador, New Foundland, Prince Edward Island, Nova Scotia, and New Brunswick. This may be due largely to lack of extensive collecting in those portions of Canada.

2. A scarcity of species in Greenland. This country is so far north and its southern portion is so separated from Canada by water that it probably has but few species anyway.

3. A paucity of species in the greater part of the Great Central Plain in the United States, especially in the most Southern States. This scarcity is most strking in Florida, the most tropical state in the Union. This part of the continent has received much attention from collectors, and it is doubtful if any new species of *Bombus* will hereafter be found in it.

4. An abundance of species throughout that portion of North America known as the Pacific Highland—from, and including a part of, Alaska to the Isthmus of Panama. This is readily accounted for by the diversified character of this part of the continent. The mountain ranges and lower lands paralleling each other in long lines running north and south make it possible for Boreal, Transition and Austral forms to exist in close proximity over a widely extended territory.

5. A similar abundance, though less marked, in the northern and middle portions of the Highland of the Andes in South America.

6. A paucity of species in Venezuela, Guiana and Bolivia probably due to lack of collecting.

7. A paucity of species in Paraguay, Uruguay, Argentina, and Chili, due in part, perhaps, to lack of collecting, but probably more to an actual scarcity.

8. The subgenus *Bombias* is represented throughout Canada, except in the following more northern and eastern sections: Yukon, Mackenzie, Athabasca, Keewatin, Franklin, Labrador, New Foundland, Prince Edward Island, Nova Scotia and New Brunswick. It is not present in Greenland. It is represented in all the States of the United States, except, perhaps, Maine; also in Mexico, Central America and the following South American countries: Colombia, Venezuela, Ecuador, Peru, Bolivia, Argentina and Chili. It is probably present also in Guiana. If present in Brazil, it is probably confined to the mountain ranges along the northern border. Its presence in Paraguay and Uruguay is to be seriously doubted.

9. The subgenus *Bombus* is present in every political division of the New World listed above (including Bolivia, though not yet so reported) and also in Greenland.

10. The *Auricomus* group is mostly confined to the Boreal Region and the Transition and Upper Austral Life Zones of North America, running over into the Lower Austral but very little at most.

11. The *Fratenus* group, in North America, ranges through the Upper Austral and Transition Zones and into the Boreal Region. In South America, it seems to be confined mostly to the Highland of the Andes, its most southern reported habitat being northern Argentina. It reaches its maximum in number of species in Peru and Ecuador, though this maximum does not appear to be much reduced even so far north as Mexico.

12. In the New World, the *Borealis* group is confined to the Boreal Region and the Transition Zone of North America.

13. The *Dumoucheli* group is the most wide spread of all the New World groups. It ranges throughout South and Central America, Mexico, the United States, southern Canada and into Alaska. It appears to reach its maximum in number of species in Mexico, but this maximum is not much reduced even so far south as Brazil and Ecuador.

14. In the New World, the *Kirbyellus* group is strictly confined to the Boreal Region, and seems to reach its maximum abundance in northern Canada and in Greenland.

15. In the New World, the *Terrestris* group is confined to the Boreal Region and the Transition and Upper Austral Zones of North America.

16. The *Pratorum* group is not present in Greenland. It is probably present in all the political divisions of North and Central America, though it has not yet been reported from either Oklahoma or Texas (the fact that both *impatiens* and *bimaculatus* have been reported from Louisiana and Arkansas and that *impatiens* is present in Florida are pretty certain indications that at least *impatiens* and *bimaculatus* are present in these two states). It also ranges through Colombia into Venezuela and Ecuador in South America, being confined to the mountain ranges in this portion of its habitat. It has its maximum number of species in Alaska, western Canada and the western United States, the variation in this number not being very great throughout this wide range.

17. The apparent absence of *Psithyrus* from South America is remarkable.

18. The *Ashtoni* and *Fernaldæ* groups in the New World are confined to the Boreal Region and the Transition Zone.

19. The *Laboriosus* group is present in a portion of the Boreal Region and it ranges through the Transition and Upper Austral Zones and a considerable part of the Lower Austral Zone. It ranges in scanty numbers through Mexico and probably through Central America also, being confined to the mountains in these regions. The record of *P. brasiliensis* from Brazil is evidently erroneous. See the discussion

following the description of that species. This group is apparently not present in South America unless it be in small numbers in the mountain ranges of the very north portion.

20. The general paralleling of the ranges of the following groups of *Bombus* and *Psithyrus* is suggestive :

a. *Pratorum* and *Laboriosus*.

b. *Terrestris* (without *affinis*) and *Ashtoni*. It should be noted, in this connection, that *P. vestalis* of the *Ashtoni* group, is said by Schmiedeknecht to live with *terrestris* and to have a distribution in Europe similar to that of that species.

c. *Borealis* and *Fernaldæ*.

21. Many of the species of the *Pratorum* group, in the northwestern part of North America, and all the species of the *Borealis*, *Kirbyellus*, *Terrestris* (*affinis* perhaps excepted), *Ashtoni* and *Fernaldæ* groups show very close affinities with European and Asiatic species, the relationship being, in some cases, so close that the American forms must be considered as only subspecies or varieties of the Old World species. A very few species even show no noticeable variation between Old World and American individuals.

If the number of specimens found in collections is a reliable indication, there is a comparative paucity of individual bumble-bees in the Great Central Plain of North America, especially in the southern United States.

Climatic Variation.

Species of *Bombus* with a comparatively level habitat of wide extent are not usually very variable. Greatly variable forms are never found except in greatly diversified regions. No North American species which has the greater part of its range east of the Pacific Highland is very variable, while several of those, the habitats of which are in Alaska, western Canada and the Pacific States of the United States, show astonishing variation in the coloration of their pile. Of these very variable forms, we may mention *edwardsii*, *pleuralis*, *rufocinctus*, *californicus* and *occidentalis* as being, perhaps, the most strking examples. Most of these variable species show the same variation to a greater or less extent in all parts of their habitat. It sometimes happens that a marked degree of variation in coloration is found even among the individuals of the same sex taken from the same nest.

In South America, the most variable species have the greater part of their habitat in the highland of the Andes.

In the coloration of the pile, those colors which may, in general, be classed as ferruginous, rufous and white are, as a rule, brought out by high altitudes and also by Arctic or sub-Arctic latitudes, only traces, at most, as a rule of these colors being found on strictly lowland forms either in tropical or temperate climates. High altitudes appear to have a much stronger influence in bringing out these colors than do high latitudes, as among the New World species, these colors attain their maximum among the Cordilleras of the Andes in Ecuador and Peru where bumble-bees reach the highest elevations. Traces of ferruginous or rufous pile on lowland temperate or tropical species (e. g.—*affinis*, second dorsal segment of worker and male abdomen; *fraternus*, apex of male abdomen; *separatus*, second dorsal abdominal segment of all sexes) may, perhaps, be taken to indicate a mountain inhabiting ancestry. In this connection, the coloration of *dahlbomii* and *emiliæ* seems to indicate that they have, in comparatively recent times, extended their habitat into eastern Argentina, southern Brazil and Uruguay.

Yellow is more or less strongly suppressed in the coloration of the pile of tropical species of the genus *Bombus*. This suppression is marked in both lowland and highland forms, and is so strong that this color is entirely wanting in a large percentage of the species in the tropics of the New World. In the lowlands this has resulted in some cases in the production of entirely black species (*kohli*, *niger*, *atratus*, *brevivillus*, *solus*). In the mountain regions black is less prevalent, for the rufous or the white pile on the mountain forms replaces the suppressed yellow more or less.

Arctic forms have noticeably longer and finer pile than have the species of warmer climates, and mountain species appear to have, as a rule, finer hair than the lowland ones.

The fact that, in both the Old and the New World, the species of the subgenus *Bombias* are, as a rule, confined in their habitat, for the most part, to mountainous regions, is interesting and perhaps suggestive. *Auricomus*, *separatus*

and *fraternus* are exceptional in this respect, but they may have had a mountain inhabiting ancestry.

No comparative study of the habits of tropical, temperate and arctic species of the genus *Bombus* has as yet been made, but it will be surprising if it is found that climate does not have a marked influence on their habits. Are the colonies of tropical species ever perennial? Are tropical colonies, as a rule, larger than arctic ones? What effect does the great parasitism of the tropics have on the habits of the tropical forms? Do the arctic species usually have subterranean nests? It should be noted, in this connection, that there are rather strong indications that the species of both the Terrestris and the Borealis groups usually have their nests underground. In tropical and temperate regions, the lowland species, at least, seem, as a rule, to nest on the surface.

Economic Importance.

Taking the world as a whole, probably the species of no other genus surpass those of the genus *Bombus* in their importance as pollen carrying agents, unless it be the species of *Apis*. In the cooler climates their season of activity in numbers is, of course, not so long as that of the honey bee. On the other hand, however, they pollenize the flowers of some plants which are not much visited by other bees, as they are enabled by their longer tongues to reach the nectar at the bottoms of long flower cups, which is out of the reach of *Apis mellifera* and most other bees. The red clover, *Trifolium pratense*, seems, in most countries, to rely mainly on bumble-bees for the transference of its pollen, while its blossoms are seldom visited by the honey bee. The white clover, *Trifolium repens*, is, on the other hand, one of the favorite plants of the honey bee. The main difference between these two clover species, from the standpoint of bee visitation, appears to be the difference in the length of the carolla tubes. If bumble-bees are the main pollenizing agents of red clover, as is commonly supposed, this clover should, as a rule, yield a heavier crop of seed when grown in the Atlantic or the Pacific Highland of North America than when grown in the

Great Central Plain, because these bees seem to be considerably less abundant in this middle portion of the continent. The bulk of the red clover crop is at present produced in the Central States. There are evidently other insects which are capable of cross-fertilizing this clover, for the writer has been informed, by the Agriculturist of the Transvaal, through Prof. C. P. Lounsbury, Government Entomologist of Cape Colony, (per litt.), that red clover ripens seed of a fair extent in the Transvaal, where no bumble-bees are present. Dr. L. Peringuey, Director of the South African Museum, Cape Town, in a letter to Prof. Lounsbury, states that, in that region, they have numerous *Anthophora* (*Podalirius*) as well suited as any *Bombus* for the cross pollenation of red clover.

Prof. W. W. Froggatt, Government Entomologist, Sydney, New South Wales, writes me that, in his opinion, bumble-bees would not do any particular good in Australia, if they could be successfully introduced there, as other long tongued bees are fairly common (Podalirius spp., and other genera). He states further that red clover is grown in Tasmania and also, to some extent, in Victoria, but only on experimental plots in New South Wales. Great quantities of lucerne are grown in New South Wales and it produces good seed there. The introduction of bumble-bees in New Zealand probably did much good as that country does not appear to have any native long tongued bees.

In New England, there is a great variation from year to year in the abundance of bumble-bees. In the summer of 1910, they were exceedingly scarce, at least in the south-eastern portion, but, strange to say, in the same section they were very abundant during the summer of 1911. The 1910 scarcity was so marked that it was everywhere spoken of by the cranberry growers on Cape Cod. It seemed to be the common opinion among these growers, moreover, that the berries did not set as well as usual that season. A marked cranberry fruiting failure on account of bumble-bee scarcity would, perhaps, be surprising, as it has been shown by experiment that the honey bee is efficient as a fertilizing agent for this fruit.

External Anatomy.

Integument.

The chitinous covering of these insects is very hard and firm in all groups, species and castes. There are considerable differences in it's toughness, however. Species of the genus *Psithyrus* have a noticeably tougher covering than have those of *Bombus* in the same sex. In *Bombus*, the queen always has a thicker integument than that of the workers and males.

The plates of the head and also of the thorax are more or less solidly fused together so as to make these portions of of the body very rigid. The abdomen is quite flexible because the intersegmental membranes allow for considerable movement, but each separate segment is in itself quite rigid, though there is enough spring in the dorsal and ventral plates to allow for considerable lateral compression, under pressure, of this region of the body.

Most of the external surface of the integument is very thickly punctate. These punctures are the places of origin of the hairs which form the clothing. There are several kinds of these hairs and there is a great difference in the relative fineness and coarseness of these different kinds. There is a corresponding variation in the size of the punctures which give settings to the hairs. The principal integumental appendages may be classified as follows:

1. Minute unbranched hairs, found principally on and around the eyes, on the antennæ, on the wings, on the mandibles, on the region in front of that bearing the long branched hairs on each abdominal segment and on the spathæ of the genitalia of the male.

2. Longer unbranched hairs, found mainly on the tongue, on the maxillæ, on each abdominal segment in front of the longer, branched hairs and on the sting palpi.

3. Minute branched hairs, present mostly on the legs (especially the tarsi), on the apex of the epipygium and hypopygium, around the eyes, on the propodeum, on the labrum and on the genitalia of the male.

4. Long, coarse hairs with short branches (fig. 18). These hairs make up most of the pile on the dorsum of the abdomen. They are also strongly intermixed on the thorax and on the head with the kind next described. They make up most of the long pile on the legs, in-

cluding the corbicular fringes, and are present to some extent on the venter of the abdomen and on the sting palpi. These hairs vary greatly in length and fineness between different species. They grade, on the tibiæ, completely into the long slender spines described under number eight below.

5. Long hairs with long branches (fig. 29). These hairs are shorter and finer than the long branched hairs just described, and are thoroughly intermixed with them on the head and thorax. On these portions of the body, they are with some species, of a different color from that of the coarser kind (*e. g.*, occiput and dorsum of thorax of *butteli*, *handlirschi*, *melanopygus*, *mixtus*, *sitkensis* and *volucelloides*), though, as a rule, the two kinds, wherever present together on the same part of the integument, are for the most part of the same color. When the two kinds are of different colors, the longer coarser kind is much the darker, and the general color resulting from the mixture of the two is grayish.

These hairs with long branches are also present to some extent on the venter of the abdomen, on the proximal ends of the legs, on the tarsi, and in the corbicular fringes, being everywhere mixed with the coarser kind. Almost every gradation between these two kinds is present, but these gradations are neither numerous nor conspicuous.

6. Minute, unbranched hairs with flat, strongly widened and truncate distal ends. These hairs are confined to the hind femora and tibiæ, clothing the entire inner faces of the latter, but being present only on the distal halves of the inner faces of the former.

7. Minute spines with conical bases. These are found only on the wings and are, for the most part, confined to those portions distad of (beyond) or behind the veins.

8. Long and slender acicular spines. These are to be found almost entirely on the front and middle tibiæ and on the metatarsi and they are the most numerous of all the spines present on those parts of the body. There are all gradations between these spines and those next described.

9. Powerful spines with blunt points, borne on the distal ends of all the tarsal segments except the last and on the front sides of the hind metatarsi.

10. Stout, flattened and somewhat curved spines placed in a single transverse row on the distal end of each hind tibia of the queen and worker. Species of *Psithyrus* do not have these spines. See figs. 12 and 48.

11. Compound spines. Two of these are present on the distal end on each hind tibia and one on the distal end of each front and each middle tibia in all groups and castes (figs. 12, 20 and 48). All of these spines are laterally denticulate or spinulate. This, together with the fact that they are the largest spines which bumblebees have and are

obviously in a class by themselves, is our reason for calling them, as a class, "compound spines." These spines have evidently been developed to perform special functions, and they will be discussed elsewhere.

The surfaces of movable chitinous plates, which are partially or entirely lapped by other plates, are usually more or less striate or reticulate on the covered portions. This is principally true of the plates of the abdomen, including the spathæ of the male genitalia (figs. 148, 152, 153, 155 and 174). Various parts of the legs are very finely reticulated, and this reticulation is, on some parts, mixed in with the punctures.

Black, yellow, ferruginous and white make up the list of general bumble-bee colors. Brown pile is sometimes very noticeable with poor specimens and is, to a slight extent, always present. This color does not appear to be normal, as a rule, for the pile (dorsum of abdomen of *handlirschi* is an exception to this and there are some others) and is, doubtless, usually the result of a failure in complete color development on the part of normally black hair. It is, however, perhaps the most common color seen in the wings, though these organs are sometimes nearly hyaline. Very dark brown wings usually have violaceous reflections also.

Black is the most universal of the bumble-bee colors. The visible portions of the integument of the main body segments, in undissected specimens, are, as a rule, almost entirely of this color.

Very few species (*handlirschi*) fail to have a noticeable amount of black pile either on the main part of the body or on the legs. As far as the clothing is concerned, this color is most constant and universal on the legs, on the venter and on the cheeks behind the eyes. It is also present on the two apical dorsal abdominal segments, on the dorsum of the thorax between the bases of tbe wings, and on the frons on a very large percentage of the New World species. It is probably least often present in any amount on the anterior portion of the thoracic dorsum.

Next to black, yellow is the leading color. While present to a greater or less extent on most species, it is entirely absent with some (e. g.—*dahlbomii*, *funebris*, *handlirschi*, *rubicundus*, *volucelloides*). It is probably most constantly

present on the anterior part of the dorsum of the thorax. It is least often found on the legs (the very proximal ends perhaps excepted), on the cheeks behind the eyes, on the venter and on the apical abdominal segment. This color shows considerable variation in shade between different species, being whitish on some while on others it is deep golden. On most species, however, this color is light, approaching the color of straw.

Next to white, ferruginous is the least prevalent color exhibited by bumble-bee pile. This color is usually confined mostly to the dorsum of the abdomen, being most often present on the middle or the apical segments. The corbicular fringes are more or less ferruginous in many species. A few species have a considerable amount of pile of this color on the thorax (*dahlbomii*, *ephippiatus*, *handlirschi*, *rubicundus*). Two species (*dahlbomii* and *rubicundus*) even have a large amount on the head. This color varies much in shade not only between different species, but also, though to a less extent, between individuals of the same species. The range is from a shade approaching very near to pale yellow to an almost cupreous color.

White is the least prevalent of the general colors of bumble-bee pile. As a rule, it is confined to the apical half of the dorsum of the abdomen. A few species have it, to a considerable extent, on the dorsum of the thorax (e. g.—*appositus* and *funebris*). White or whitish pile is noticeably present on the head of *appositus*, *borealis* and *edwardsii*. Pile of a gray or cinereous color is present on some parts of the body of some species as has already been noted under the description of the various integumental appendages.

The various species may be classified according to the coloration of their pile under the following heads:

1. *Unicolorous*. Entirely black species of which there are but few (*kohli*, *niger*, etc.).
2. *Bicolorous*. These are as follows:
   (a) black and yellow (e. g.—*impatiens*, *morrisoni*, *sonorus*).
   (b) black and ferruginous (e. g.—*dahlbomii*, *dolichocephalus*).
   (c) black and white (e. g.—*funebris*).

3. *Tricolorous.* These are as follows:
   (a) black, yellow and ferruginous (e. g.—*huntii, pulcher*).
   (b) black, yellow and white (e. g.—*appositus, robustus*).
   (c) black, cinereous and white (e. g.—*volucelloides*).
   (d) black, ferruginous and white (e. g.—*coccineus*).
   (e) cinereous, ferruginous and brown (e. g.—*handlirschi*).
4. *Quadricolorous.* Very few species, the colors being:
   (a) black, yellow, ferruginous and white (e. g.—*sulfuratus*).
   (b) black, white, ferruginous and cinereous (e. g.—*butteli*).

Of the New World species, the largest number are tricolorous and, of these tricolorous forms, the "black, yellow and ferruginous" ones outnumber all the others by more than two to one. Next in numbers to the "black, yellow and ferruginous" species are the "black and yellow" ones of the bicolorous series, these outnumbering by two to one all the others of that series. The coloration of the male is, in some species, strikingly different from that of the females and, in *Bombus*, there is also sometimes a considerable difference in this respect between the worker and the queen.

Head (fig. 53).

The hypognathous head is of good length and thickness, but is rather narrow in comparison with that of most other bee families. Its usual form might, perhaps, be best described as sub-triangular. There is, however, great variation in its shape among the various species, it being rather strongly rotund in some, while in others it is elongate triangular. This varying shape of the head is of considerable value in classification, especially as, within each natural group of species, it is more or less constant and characteristic. In profile, the head appears somewhat convex in front.

The different sclerites forming the head are so completely fused as to be indistinguishable, and we can therefore designate the regions of the head only in a general way. The occiput is, in this paper, considered to extend from the neck (junction of head with pronotum) up and over the occipital ridge and forward to the supra-orbital line (the line tangent to the extreme upper ends of the eyes. It is shorter in some species than in others because of the greater upward extension of the eyes in all castes of those species.

The vertex is considered as extending from the occiput half-way down to the supra-antennal line (the line tangential to the upper sides of the antennal attachments). While the occiput appears to provide no good classification characters aside from its varying length and the color of its pile, the variable position of the ocelli on the vertex of all castes is of much assistance in marking the limits of certain groups of species which have been, in this paper, placed together in the subgenus *Bombias* for reasons given in another place. This character is also useful, to a considerable extent, in the separation of the different species of these groups. With the males of the *Bombias* species, the vertex is usually more or less narrowed toward the occiput. The frons extends from the vertex to the clypeus and also, in triangular extensions, down on each side of the clypeus to the malar space. A median groove extends from the middle ocellus down to the upper portion of the frons. There is a short carina between the antennal insertions. Aside from the color of its pile, the frons appears to be without value in classifying species. The clypeus is a trapeziform plate occupying the lower portion of the front of the head. It is marked off from the frons by quite strong sutures. It's surface is rather strongly convex and the labrum is attached to its lower margin. This plate is of some taxonomic value as its punctation varies greatly between different species, though it is apparently very constant within species and sex limits. The clypeus of the males is usually well covered with hair, while that of the females, in *Bombus* at least, is mostly naked. The comparatively smooth and hairless area between the lower end of the eye and the base of the mandible, on each side of the head is, in this paper, called the "malar space." This region is probably made up partly from an extension of the frons and partly from a forward extension of the gena. It varies greatly in length between different species and is of much taxomomic value. The sides of the head, behind the eyes, are known as the cheeks or genæ. There is no line of demarcation between the genæ and the occiput, the mutual limits of these plates being indefinite. The cheeks are

widest behind the upper halves of the eyes and are much narrowed toward the mouth; they have little taxonomic value.

The appendages of the head will be considered in detail separately.

Antennæ (figs. 19, 21, 23, 25 and 27).—These organs are inserted upon the front part of the head opposite the middle of the eyes. These insertions are usually a little nearer to each other than they are to the eye margins, but in some males (*Bombias*) they are nearer to the eyes than to each other. The basal portion or bulb of the proximal segment or scape articulates with the head in a socket. This bulb has a slightly smaller diameter than does the main portion of the scape where it is thickest. There is a strong constriction between the bulb and the rest of the scape, the most of the narrowing being on one side (figs. 21 and 27). The scape is much the longest segment of the antenna. The comparative lengths of the scape and the flagellum (the rest of the antenna without the second segment) do not appear to vary greatly among the females of different species, but, among the males, they do vary very considerably. The scape is fully two-thirds as long as the eye. It is thickest toward either end. The flagellum is usually carried at an angle with the scape, thus forming what is known as a geniculate antenna. The second antennal segment is known as the pedicel. This segment is by far the shortest of all the antennal segments. Its apical portion is usually sub-globular, but it is more or less constricted basad. The flagellum consists of ten segments in the females and eleven in the males. These segments vary considerably in length between the males of the various species and between the two sexes. The first segment always gradually increases in diameter more or less from the proximal to the distal end. The relative lengths of the first three segments are of considerable value in classification. The terminal segment (fig. 58) is always compressed or flattened more or less apically so as to appear wedge-shaped when viewed laterally. The middle segments are usually straight and cylindrical, but in the an-

tennæ of some males are somewhat curved from end to end. The term "arcuate" is used to express this curved condition (fig. 17). In some males, the segments of the flagellum are rather strongly convex on one side so as to produce, for that side of the flagellum as a whole, a condition which, in this paper, is described as "crenate" (fig. 23). The males of *B. mixtus* are peculiar in having a noticeable tuft of hair on the same side of nearly all the segments of the flagellum (fig. 19); the tufts on the basal segments being longer and much more noticeable than those on the apical ones. This species excepted, neither the flagellum nor the pedicel bear long hairs; though such hairs are present on the scape more or less. Minute ferruginous hairs are very numerous over practically the entire flagellum and pedicel. Mixed in with these hairs on one side of all the segments of the flagellum, except the first two, are shallow elliptical depressions or pits in the antennal integument. These pits are scattered over about half the surface of these segments. They are also present on a small area on one side of the apical portion of the second segment. Each of these depressions appears to be either lined or covered with a silvery scale or membrane. Figure 56 shows the outlines of several of these pits with the smaller hair punctures mixed in with them. These depressions may be sense organs. They are present in all species and castes.

Organs of Vision.

Eyes.—The compound eyes are usually and narrow with rounded ends, and are placed antero-laterally on the head. They follow to some extent the curvature of the sides of the head and are, therefore, themselves convex aud usually somewhat arcuate from end to end. In some males (*Bombias* spp.), they are greatly widened, lengthened and swollen and very convex, bulging out from the sides and the top of the head. The proportional length of the eyes varies very considerably between *Psithyrus*, the subgenus *Bombus* and the subgenus *Bombias* and also between various species of the latter subgenus. It is least in *Psithyrus* and greatest in *Bombias*. The elongation of the longer eyes is effected by

an extension of their upper ends. This extension encroaches on the occiput. For this reason, the occiput of *Bombias* species is, as a rule, noticeably shorter than that of *Psithyrus* and the subgenus *Bombus*. The females of *Psithyrus* have noticeably shorter eyes than those of any *Bombus* females of equal size. The eyes of *Psithyrus* males are also somewhat shorter but not as noticeably so as those of the females. As a rule, a few minute simple hairs may be found scattered over the surface of the eyes. In freshly emerged specimens the eyes are often noticeably hairy, particularly in the males. These hairs are attached between the facets. The eyes are often of nearly the same color as the surrounding integument, but usually they are much lighter and of a color that might, perhaps, be best described as light silvery brown or pale smoky gray. They are also sometimes irregularly mottled more or less.

Ocelli.—These organs are three in number and are arranged in a curved line on the vertex. Their position in relation to the eye margins and to the supra-orbital line is greatly affected by the amount of extension of the upper ends of the faceted eyes. In some forms (*Psithyrus* and *Bombus*) they are either tangent to or on the supra-orbital line, and the lateral ones are as far from the eye-margins as they are from each other. In others (*Bombias* spp.), they are far below the supra-orbital line and the lateral ones, in some males, almost touch the eyes. The ocelli are noticeably larger in proportion to the size of the individuals, in both females and males of many species of *Bombias* than they are in any species either of *Psithyrus* or of the subgenus *Bombus* known to the writer. These organs are sometimes black like the surrounding integument, but usually they are somewhat yellowish. They are never as light as the usual color of the faceted eyes. The surface of the integument near them is, for the most part, but slightly punctate.

Mouth Parts.

Of these organs, only the labrum and the mandibles appear to present characters of any value in the determination of species. The other parts will not, therefore, be con-

sidered here in detail. They are in general much like those of the honey bee, but the tongue and maxillæ are much longer than in *Apis*, the former, when fully extended, reaching back to, or often even considerably beyond, the middle of the abdomen. The labial palpi are four segmented and the maxillary palpi normally two segmented.

Labrum (figs. 51, 103, 107 and 114).—This organ is of some assistance in classification. In *Bombus*, it is transversely oblong in general form in all castes. The males of *Psithyrus* are like *Bombus* in this regard, but in the females of that genus the labrum is rather strongly triangular in general outline (fig. 103). The side margins are always outcurved. The line of attachment with the clypeus is always nearly straight in the middle and in *Bombus* usually bends forward (away from the clypeus) somewhat on each side. The apical margin is most often nearly straight, but it may bend either outward (*Psithyrus* females and, to a less degree, some other forms) or inward (fig. 114). If the labrum of the females of some species (e. g.—*consimilis*, *perpexus*) is detached, mounted and examined with a microscope or even with a good hand lens, looking toward a strong light, a conspicuous light "*translucent area*" will be seen near each end. *Psithyrus* and the males of *Bombus* do not have these areas. In many species of *Bombus* they are also partially or entirely obliterated in the females (queens and workers). In the females (queens and workers) of *Bombus*, the labrum bears a noticeable median transverse shelf-like projection or carina (fig. 114) near its apical margin. Each end of this carina ends in a somewhat elevated area. These areas are called "tubercular areas" and "tubercle-like areas" in the various specific descriptions in this paper. These areas vary in their amount of elevation in different species, and they usually consist of an irregularly circular, moderately elevated, and rounded ridge enclosing a more depressed area. Between these "tubercular areas" and above the carina, the surface is usually more or less strongly depressed. In *Psithyrus* females this surface structure of the labrum is often considerably modified. The transverse carina is sometimes reduced

to a rather sharp apical tubercule and each tubercular area is sometimes represented by a similar rather acute tubercle. The labrum of the *Psithyrus* female is, therefore, often noticeably trituberculate, the tubercles being arranged in a triangle. The males of neither *Bombus* nor *Psithyrus* have any carina or "tubercular areas" or tubercles on the labrum. In both genera and in all castes the surface of the labrum is more or less strongly punctate. Where "tubercular areas" are present their depressed portions are comparatively smooth.

Mandibles.—In the females, these organs are well developed and appear moderately powerful. They are broad toward the base and apex, but are narrowed considerably in the middle. In all the New World species of *Bombus*, the apex of the female mandible is normally either three- or four-toothed. Freaks of species with normally four-toothed mandibles sometimes have them five-toothed (fig. 37). In the three-toothed mandibles, the two teeth on the front side are small and more or less acute (fig. 41. T. 1 and T. 2) and the third tooth (T. 3) is very broad and forms the greater part of the biting edge. In four-toothed mandibles, the fourth tooth (T. 4) is a small tooth on the hind side. Many species have mandibles showing a partial gradation between the three- and four-toothed condition (fig. 45). In *Bombias* (fig. 30), the hind side of the biting edge of the female (queen and worker) mandible is more extended distally, in comparison with the front side, than it is in the subgenus *Bombus* (fig. 45). In *Psithyrus* females, this hind side of the biting edge is very greatly extended (figs. 46 and 49) and is much more acutely rounded than in the genus *Bombus*. The mandibles of female Psithyri are not distinctly toothed. The biting edge, however, usually has a single notch. The outer faces of the mandibles of both genera are convex and marked by alternating longitudinal ridges and grooves, the grooves being lined to a considerable extent with a very short and fine, usually ferruginous pubescence. The inner faces of their distal halves are strongly concaved and smooth except for a single curved ridge which runs from the front margin over

two-thirds of the way across toward the hind end of the biting edge. The mandibles of the male are bidentate in both genera, the front tooth being the smaller, and in most species they are heavily beardered on their outer faces, especially toward their bases (figs. 33 and 38).

Thorax. (Figs. 1 and 2).

The apparent thorax, as in most other Hymenoptera, includes, in addition to the thorax of other insect orders, the first abdominal segment. This segment and the plates of the meta- and mesothorax and the pronotum are firmly joined together and form a box, the parts of which are practically immovable in relation to one another. This box is as wide (from side to side) as it is long (from front to rear) and wider than it is deep (dorso-ventrally). Viewed posteriorly or anteriorly (with the head and abdomen removed), it appears nearly round. Viewed laterally, it appears nearly triangular.

The most striking features of the thorax are the following: (1) The great development of the mesonotum and mesopleura is accompanied by a great reduction of all the sterna and of the metathorax. (2) The lateral and ventral parts of the prothorax are suspended loosely in a large membranous area which is continuous anteriorly as the neck. They thus form a sort of suspensorium for the front legs, which is easily detached from the rest of the thorax. (3) The pronotum is solidly attached to the anterior edge of the mesothorax, and its lateral parts extend downward till they meet on the venter behind the prosternum. (4) The post-notum (post-scutellum) of the mesothorax is entirely invaginated into the cavity of the thorax, thus being invisible externally, and is reduced to the form of two lateral arms of the large internal postphragma.

Having considered the general appearance and make-up of the thorax, we may now proceed to a more detailed description of it.

Prothorax.—The head is attached to the thorax by means of a very flexible membrane. The place of attachment on

the head is located at the center of a circular concavity which permits of a free movement of the head on the body. The occipital foramen is rectangular or rounded in general form, its long axis being the vertical one. The anterior ends of the two episterna of the prothorax forms knobs which loosely articulate with the occipital region of the head. The neck membrane on the dorsal side is attached to the lower surface of the pronotum.

The pronotum is so separated from the rest of the prothorax that it almost appears to belong to a separate segment. It forms a collar completely encircling the front of the mesothorax and extends backward on each side in the form of a large lobe which reaches the tegulæ. This lobe acts as a protective shield, covering the first thoracic spiracle. The notum is divided by a transverse groove or depression into an anterior and a posterior part. The former is sometimes called the scutum and the latter the scutellum. The scutellum is densely pilose, but the scutum has very much less hair. The propleura are large, oblong plates, presenting both lateral and ventral surfaces. They are retracted beneath the notum so as to be at most only partly visible laterally. Each pleuron appears to be made up of a single piece, which is apparently the episternum. The prosternum is a small, partly invaginated plate. It is widest in the middle and narrows to an acute angle both in front and behind. Its surface is often longitudinally striate in the middle.

Mesothorax.—The mesonotum consists of three plates. Of these plates, only two, the scutum and the scutellum, are visible with the plates in their natural position. The scutum is the large anterior plate which extends from the pronotum back to opposite the bases of the hind wings. Its anterior corners reach under the prothoracic lobes slightly. It has a very narrow strip on each side which appears to be partially separated from the main part by a suture. The scutum, as a whole, is widest anteriorly. Its front margin curves forward somewhat; the side margins are somewhat incurved and the hind margin is broadly curved backward. Its sur-

face, as a whole, is thickly and coarsely punctate and densely pilose. A little behind the center, however, there is a less punctate area, a small part of it usually being entirely smooth. As the hairs, which form the pile, arise from the punctures, this smoother area is usually more or less naked. From this area a single fine median stria runs forward to the anterior margin. Somewhat less than half the way from the side margin to the middle line and about midway between the front and hind margins, on each side, is a short groove or stria. These lateral striæ are known as the parapsidal grooves. The pile on the hind part of the scutum, between the bases of the wings, is often of a strikingly different color from that on the front part and on the scutellum, so that it forms a very noticeable transverse band. This band is, in this paper, called the "*inter-alar band.*"

The scutellum lies behind the scutum and is separated from it by a very distinct suture. It is less than half as large as the scutum. It overhangs the middle of the metanotum behind. It has two small latero-anterior areas, which are partially separated from the median area by sutures. It is lunate in form, both the front and the hind margins being curved backwards. Most of its surface is densely punctate, but it is much less so on the medio-anterior portion and on a median line running backward nearly to the hind margin. Except on this less punctate portion, it is densely pilose. If the mesonotum is separated from the rest of the thorax, a large posterior internal part is found attached by two lateral arms to the scutellum. This structure does not show on the surface at all. As Mr. R. E. Snodgrass, in his splendid work on the anatomy of the honey bee (Technical Series, No. 18, U. S. Department of Agriculure, 1910, p. 55) has shown, it is the representative of the post-scutellum and its phragma.

The mesopleura are very large and make up most of the sides of the thorax. Below, they are completely fused with the mesosternum, with no suture to indicate the limits of the latter. Above, they reach the bases of the wings. Each mesopleuron is made up of a small double upper plate, known

as the epimeron, and a large lower plate, called the episternum. A distinct sinuous suture separates these two plates. This, the pleural suture, does not reach more than half-way from the wing base to the base of the middle leg. The surface of the mesopleuron is densely punctate and pilose. The sternal region is somewhat infolded longitudinally in the middle. In the middle of this infolding there is a fine longitudinal elevated line. Between this sternal region and the ventral ends of the pronotum is a small transverse membraneous area.

Metathorax.—This part of the thorax consists of a very narrow series of plates compressed between the mesothorax and the median segment or propodeum. The metanotum is a single, narrow, transverse sclerite, widening on the sides where it carries the wings. Its middle portion is overhung and partially concealed by the scutellum of the mesothorax. A slanting groove appears to separate the lateral portions of this plate from the middle portion. These lateral portions are densely punctate and rather heavily pilose, while the middle portion is comparatively smooth and bears only a small amount of short hair.

The metapleuron consists of an upper and somewhat anterior plate, supporting the hind wing, and a lower and posterior plate, carrying the hind leg. The upper plate is elongate-oval in shape and its surface is densely punctate; it is moderately densely pilose. The main part of the lower plate is triangular, and from the corners of the triangle three long, narrow extensions reach out. One of these extensions passes between the middle and hind coxæ and connects with the metasternum; another reaches up between the propodeum on one side and the middle coxa and mesepisternum on the other and conneets with the upper plate; the third extension is shorter than the other two and reaches back between the hind coxa and the propodeum. This lower plate does not have much long hair. As Mr. Snodgrass has shown, no distinction as to epimeron and episternum can be made in the consideration of these plates.

The sternum appears to consist of a small, nearly trapezi-

form, anterior plate, located between the mesocoxæ, and a separate triangular, posterior scale-like piece which extends from this anterior sclerite back between the hind coxæ and reaches the edge of the median segment by means of two rami or arms. These arms bound the abdominal foramen (the opening into the second abdominal segment) below.

Propodeum.—This large single sclerite, as has been abundantly proved, is really the notal plate of the first abdominal segment, which has become thrown forward and joined solidly to the thorax, the corresponding ventral plate having become lost. It fits into the hollowed out posterior edges of the metathorax. Its surface is convex and it bears the first abdominal spiracles laterally. These spiracles are elongate and curved from end to end. The surface is finely punctate in the middle and densely and coarsely punctate on the sides. It is divided into an upper median area and two lower lateral areas by two delicate, slanting and sinuous grooves which meet on the middle line near the lower margin. It bears only short pubescence on the middle portion, but there is usually considerable pile on the sides.

Abdomen.—Without the propodeum, the abdomen of the females (queen and worker) has six exposed segments fig. 1) and that of the male seven. With the male, however, only the tergum of the seventh segment is exposed, its sternum being the outer spatha of the genitalia. For convenience, the propodeum has not been considered in the numbering of the segments in the detailed descriptions of the various species; they have there been numbered from front to rear as though what is really the second segment were the first one. Counted in this way, the tergum of the first segment is the largest abdominal sclerite. It has a large triangular, anterior face and it runs down onto the venter on each side and overlaps to some extent the comparatively small ventral plate or sternum. Its anterior face is usually either concaved or furrowed longitudinally in the middle; this face has only very fine punctures for the most part and does not bear much pile. In the attachment of this segment with the thoracic box, its tergum connects with the lower

edge of the propodeum, and its sternum with the posterior sides of the rami of the hind plate of the metasternum. It should be noted here, however, that the plate, which is here considered a part of the metasternum, may really be the nestigial neutral plate of the propodeum. The foramen at this connection is, on the thoracic side, a double one, and consists of a lower triangular and an upper circular opening, the two openings running together to a slight extent. On the abdominal side, however, only the lower triangular part of this foramen is present. This is due to the fact that a short tubular membrane, open to a slight extent below, runs back from the circular opening of the foramen on the propodeum and ends blindly like a sack, the end covering over and enclosing a small Y-shaped extension of the integument, which arises at the lower margin of the first abdominal tergum and extends upward and backward a short distance lying closely against the very lower part of the anterior face of the tergum. This membraneous tube encloses a pair of small levator muscles or tendons, and the Y-shaped extension gives them attachment and leverage for raising the abdomen. The Y-shaped piece together with the tubular membrane and the enclosed muscles make up what is known as the funiculus.

Segments two to five, inclusive, of both the female and male abdomen are very similar in general form and structure. Each one consists of a tergum and a sternum, the former reaching far down on each side of the segment, where it carries the spiracle and overlaps the edge of the sternum. Each of these terga and sterna is transversely oblong, and is widely overlapped by the one next in front of it. The intersegmental membrane in every case runs from the anterior edge of the tergum or sternum and attaches to the middle of the inner face of the one in front of it. The exposed portions of most of the terga and sterna are coarsely punctate and bear long hair, the terga being—in *Bombus*—densely clothed. The covered portions are mostly without punctures and bear little or no hair. The sides of the first sternum and the adjacent portions of the sides of the first tergum are

without punctures or hair. They are, however, very delicately reticulated, though, to the unaided eye, they appear perfectly smooth and shining. The smooth and hairless condition of these areas is evidently due to their friction against the hind coxæ.

The last exposed segment in both sexes is different in form from the ones that precede it. In this paper, the last exposed tergum is called the *epipygium* and the last exposed sternum the *hypopygium* (figs. 28 and 43). The last exposed segment, taken as a whole, is pyramidal and bluntly pointed at the apex in the females, the sixth tergum and sternum opposing each other as epipygium and hypopygium. In the males, the seventh tergum is convex above and broadly rounded at the apex. In this sex the seventh tergum is the epipygium and has the sixth sternum opposed to it as the hypopygium. The thorax and all the anterior segments of the abdomen possess no particular characters of value in species determination aside from the character of the pile. The hypopygium, however, often presents distinctive structural characters. In the females of *Psithyrus*, it has a strongly elevated carina on each side of the apical portion (fig. H). These elevations are absent in *Bombus*, but some *Bombus* females have a slight median carina on the apical portion.

Within the cavity of the last exposed segment are lodged the sexual organs and their appendages. All the details of these structures have not been fully worked out by the author, but, as far as they have been studied, they will now be described for the two sexes separately.

The sting and its appendages (fig. 16).—In general structure and relationship, these organs are much like those of the honey bee already so well described by Mr. Snodgrass (same paper as previously cited). The sting itself is a somewhat curved, tapering shaft with its tip directed posteriorly and its base swollen into a bulk-like enlargement. This shaft is not solid, but is a hollow organ made up of three pieces which surround a central canal. One of these pieces is dorsal and the other two are ventral. The ventral pieces slide lengthwise on track-like ridges of the dorsal piece, the latter

being open below to a slight extent from base to apex. The dorsal piece is known as the *sheath*. It consists of a prominent and elongate basal swelling, which contains a large cavity and is known as the *bulb*, of a terminal tapering *shaft*, and of two elongate, curved, foliaceous *basal arms* or *roots*. The two ventral pieces are long slender rods, called the *lancets* or *darts*, which slide freely upon two tracks on the ventral edges of the sheath and diverge upon grooved tracks running the entire length of the basal arms. These lancets have several small teeth or barbs on one side near their distal ends. The cavity of the sheath bulb, in a narrowed extension, continues through the entire length of the shaft of the sting as a channel running between the sheath and the lancets. This channel is the *poison canal* of the sting.

Several paired plates of definite shape and arrangement are attached to and overlap the base of the sting. None of these plates appear to have any taxonomic value, and only two of them need to be considered in detail. One of these paired plates may be called the *palpus plate*, for to each plate of the pair is attached an elongate hairy organ, these organs being known as the *sting palpi*. These palpi are very prominent and are dorsal to the sting. The plates which bear them also support the basal arms of the sheath and are connected by a membrane which lies against the bulb of the sting. The plates of the other paired plate, which deserves attention, bear spiracles and appear to represent a part of the eighth abdominal segment (the propodeum being considered as the first), most of the other plates present representing the ninth segment. These *spiracle bearing plates* (figs. 24. 104, 106, 116 and 118) show considerable variation in form between the various species and also, to some extent, between different individuals of the same species.

A membrane extends across between the two basal arms of the sheath of the sting. The inner margin of each of these arms is usually gradually extended more or less into an inconspicuous lobe. In the species of the Terrestris group, this lobe is divided into two well developed teeth in the queen and sometimes in the worker also. These lobes

are slightly elevated and somewhat excavated beneath. These lobes are always less developed in the workers of *Bombus* than they are in queens of the same species (figs. 149 and 176). The writer has seen queens of *Bombus* with the male genitalia, torn from the body of the male, hanging to the bases of their stings, in position for copulation. When thus observed, the male sagittæ were always found passing between the lobes on the inner sides of the basal arms of the sheath of the sting above described. It seems evident, therefore, that these lobes have some function in connection with that of the sagittæ. They apparently serve to guide the heads of those organs to the mouth of the vagina. For this reason, they are, in this paper, called the *genital guides*. In general, they are largest and most complex in those species which have the sagittæ of the male with the largest and most complex heads.

Male genitalia (figs. 119 and 120).—These organs are as follows:

1. Two ventral and basal foliaceous slerites, one underlying the other (fig. 32). These are, in this paper, called the *spathæ*. Together they make up what Radoszkowski designated as the *couvercle genital*. They vary greatly in form between different species and are, therefore, of some value in classification. The outer spatha is always the larger (figs. 122 to 126 inclusive and figs. 148, 152, 153 and 155) and always has its anterior margin curved far backward in the middle and usually is entirely without fenestrae. The inner spatha is always roughly triangular in outline and always has its anterior margin thickened and extended forward prominently in the middle and usually has at least one fenestra (fig. 128). These spathæ always have more or less hair on the apical portions of their outer surfaces.

2. A single large, dorsal and basal sclerite. This plate is known as the *cardo* (figs. 71, 119 and 120, C). It forms the entire basal portion of the genitalia on the dorsal side and, in narrow and tapering extensions, it reaches down on each side of the venter to over one-half the distance toward the middle line. By its connecting membranes it provides most of the attachment for the genitalia to the rest of the abdomen. It is smooth and without hair. It is quite constant in form and appears to have no distinctive character of value.

3. A lateral organ on each side known as the clasper (figs. 71, CL and 120, CL). During copulation, these organs include the basal portion of the female stinging apparatus between them. The presence of numerous muscles indicates that muscular effort is put forth in the use

of the claspers, but this may be considered as doubtful. Each clasper is made up of three separate pieces as follows :

(a) The large basal and lateral piece which in a tapering basal extension reaches the middle line on the ventral side and there fuses, in a narrow connection, with the corresponding extension from the other clasper and which also nearly reaches the middle line in a basal extension on the dorsal side. This piece is smooth and with little or no hair. It is known as the *branch* or *stipes* (figs. 71, 73, 119, 120, B). It varies greatly in form, especially as seen on the dorsal side, between the various species.

(b) A small apical and dorsal piece attached to the distal end of the stipes. This plate is typically two lobed, but either the inner or the outer lobe may be greatly reduced, the former being sometimes entirely absent (fig. 158). This plate is called the *squama* (figs. 119 and 120, T, and figs. 71, 73, 74, 77, 78, T). Its two lobes appear to have different functions. The outer one evidently acts as a brace for the end of the vosella which, in most species of *Bombus*, would, without it, probably be either bent dorsally or broken by the pressure of the female hypopygium against the middle of the dorsal sides of the claspers, the tips of the volsellæ being held fast from slipping on the plates dorsal to the basal arms of the sting by means of their apical projections. The necessity for this bracing is shown by the fact that the branch reaches cauded considerably farther on the dorsal than it does on the ventral side and also by the fact that this outer lobe is, as a rule, longest and best developed in those species which have the ends of the volsellæ reach farthest beyond the apices of the branches. The function of the inner lobe is not known. It is, as a rule, best developed in those species which have sagittæ with very simple heads. There appears to be a phylogenetic significance connected with this. The squamæ are, for the most part, without hair, but the inner lobe often bears considerable. They are of great value in the classification of species.

(c) A large and usually very hairy piece attached to the inner side of, and partly enclosed by, the stipes. This piece is known as the *volsella* or *lacinia* (figs. 71, 73, 93, 119 and 120, V). It varies greatly in its form and in the amount and distribution of its hair between the different species. Its caudad extension, has compared with that of the branch and squama, is also very variable between the various species and is of especial importance, as it seems to have some phylogenetic significance. The apex of the volsella in *Bombus* bears a conspicuous, usually pointed and ventrally recurved projection on its dorsal and inner side. This projection is, in this paper, called the *apical projection* (figs. 71, PR, and 119, PR). Its function, apparently, is to enable the volsellæ to keep a firm hold on the side plates at the base of the sting and so keep that organ in an extruded position during copulation, the claspers thus acting not only as pincers, but also functioning

as levers over the apex of the female hypopygium as a common fulcrum. The apical projection of the volsellæ are absent in *Psithyrus*. The hairy condition of the volsellæ seems to indicate that they may be of some use as sense organs. At the base of each, on the ventral side and largely enclosed by the branch, is a small piece called, in this paper, the *nux* (fig. 71, NX).

(4) An elongate, usually slender, organ on each side, between the claspers. These pieces are known as the sagittæ (figs. 71, 119 and 120, H and Y). Their distal ends are variously modified in form among the different species and usually have more or less strongly recurved parts. The modified terminal portion of these organs is, in this paper, called the *head* (figs. 71, 119 and 120, H), while the long basal part is called the *shaft* (Y). The sagittæ are of great value in the classification of species. As has been indicated in the discussion of the female organs, their heads are plunged into the vagina ahead of the penis, and serve to open it for the insertion of that organ. When the sexual connection is fully established, separation is probably very difficult in some species on account of the sagittal heads. It is certain that the male organs are sometimes torn completely off from the males in this separation. The heads of the sagittæ, in most species, are extended ventrad more or less strongly, and they often bear some microscopic hairs. The sagittæ attain their greatest complexity of form in the *Terrestris* group. This, together with the noticeably reduced volsellæ, the four-toothed female mandibles and the probably almost universal subterranean nest building habit, marks this group as the most specialized of all the bumble-bee groups thus far recognized.

5. A median and dorsal organ known as the *uncus*. Radoszkowski (Bull. Soc. Natural. Moscow XLIX, P. 1, 1884, p. 53) called this piece the spatha, but I have seen fit to use that name for the two ventral pieces making up the genital couvercle. The uncus is always narrowed toward the distal end and this end is always curved strongly ventrad (figs. 71, 73, 119 and 120, U). It varies greatly in width between species. It overlays the bases of the sagittæ. Its surface is smooth and it is without hair. It appears to function as a protection and guide to the penis.

6. The *penis* is a flexible and membraneous organ which is deeply retracted under the base of the uncus when not in use. Its distal end is much enlarged.

Certain parts of the male genitalia are modified abdominal segments. Counting the propodeum as the first abdominal segment, the *cardo* represents the ninth tergum, the *outer spatha* the eighth sternum, and the *inner spatha* the ninth sternum. The tenth segment appears to be absent as far as any representation by chitinous plates is concerned.

The most striking differences in genitalia, between *Bombus* and *Psithyrus*, are presented by the volsellæ. The volsellæ of *Bombus* are hard and horny and have well developed apical projections. Those of *Psithyrus* are semi-membraneous and are destitute of apical projections. The weak volsellæ of *Psithyrus* seem to indicate that in that genus the legs are used to grasp the females, during copulation, more than they are in *Bombus*. The lateral elevations on the female hypopygium of *Psithyrus* may have some use in this connection.

Wings.—These organs are large and powerful. They vary in color, between the various species and castes, from nearly hyaline to very dark brown with violaceous reflections. Over the base of each fore wing, lies a small, arched, chitinous plate, known as the tegula (fig. 47). This plate is rather pointed at one end, but is broadly rounded at the other. Toward the pointed end, the outer surface is rather thickly punctate and bears considerable long hair. Besides the tegulæ, there are several other, though smaller, chitinous pieces connected with the bases of the four wings. These have not all been studied in detail by the writer, but two of them, larger and more conspicuous than the rest, may be mentioned here. One of these pieces (fig. 52, SC) is sub-triangular in general outline and lies, for the most part, on the front side of the base of the wing. This piece is the *enlarged basal portion of the subcosta* of Comstock's classification, the remainder of that vein having entirely disappeared. The other piece (fig. 52, AP) runs from the middle of the wing base back beyond the hind margin of the base. This piece is elongate, rounded in front and pointed behind. It is known as the *median plate of the wing base* or the *median basal plate*. There are also several small pieces connected with the bases of the hind wings, but these have not been studied by the writer.

The nomenclature of the veins and cells, used by Cresson and others, has been followed in this paper, but drawings have been included which name the parts according to the Comstock system (figs. 3, 4, 7, 8).

Fore wings (figs. 3, 5, 7 and 9).—The *radial* cell is elongated and very narrowly rounded at its outer end. There is

no well developed stigma. Three closed *cubital* cells are present and they are of nearly equal size. They lie between the costal cell, the weak stigma and the radial cell in front and the first and third discoidal and second apical cells behind, the vein between these last and the cubital cells being the *cubital vein*. A fourth, weakly developed, cubital cell is present on the distal side of the third and is open externally. The veins which separate the cubital cells from each other are the *transverse-cubital* veins. The first cubital cell is widest in the middle and is pointed at each end. It is, as a rule slightly wider, from front to rear, in *Psithyrus* than it is in *Bombus*. It is faintly divided in the middle by an apparently rudimentary and usually incomplete veinlet. The second cubital cell is bordered, in front, in part by the radial cell and in part by the first cubital. It comes to a point immediately behind the middle of the latter. The second transverse-cubital vein is nearly straight, while the third is strongly outcurved. The radial cell reaches considerably beyond the third cubital. Two of the three cells, immediately behind the cubitals, are closed and are termed the *first* and *third discoidal cells*, while toward the tip of the wing from the last named is the unclosed *second apical cell*, which lies posterior to the outer portion of the third cubital cell. Separating the first and third discoidal cells and the second apical cell are two *recurrent* veins, the first of which arises posteriorly from the anterior outer angle of the *second discoidal* cell, which lies posterior to the first discoidal cell, the second recurrent vein arising from the *sub-discoidal vein*. The *first recurrent vein* joins the cubital opposite the middle of the second cubital cell. The *second recurrent vein* joins the cubital at a point somewhat proximad of the apex of the third cubital cell. Behind the third discoidal cell is the *first apical cell*, the vein that separates them being the *sub-discoidal*. The vein separating the first and second discoidal cells is known as the *discoidal vein*. The anterior-basal cell is very long and narrow and is called the *costal* cell. It is separated from the very long, but broader, *median cell*, which lies immediately behind it, by the *sub-costal* vein. With the possible exception of the

first discoidal cell, the median cell is the largest cell in the wing. It is bounded distally by the slanting, but nearly straight, *basal vein*, and the *median vein* separates it behind from the elongate and narrow *submedian cell*. The distal end of the submedian cell is limited by the *transverse median vein*. In *Psithyrus* and the subgenus *Bombus*, this vein forms an obtuse inner angle with the median vein and coalesces for a short distance with the base of the discoidal vein. In *Bombias*, the inner angle formed with the median vein is acute and there is practically no coalescence with the discoidal vein (fig. 14). The submedian and second discoidal cells are limited behind by the *anal* vein. Posterior to the anal vein is the long, narrow and open *anal* cell. The basal portion of the wing is margined in front by the *costal* vein. The outer part of the wing is free from closed cells. Along the margin of the wing, behind the distal portion of the anal cell, is a downward fold of the wing membrane. This is known as the *frenal fold* and, with the frenal hooks on the front of the hind wing, it serves to hold the two wings together in action.

Hind wings (figs. 4, 6, 8 and 10).—The hind wing has but three closed cells. They are all elongate and basal. The anterior one is very narrow and is called the *costal cell*. It is bordered in front by the *costal vein* and separated behind from the *median cell* by the *sub-costal vein*. The median cell is the largest cell of the wing. It is widest in the middle and tapers toward both ends. It is separated from the *submedian cell* behind it by the *median vein*. The sub-median cell is limited distally by the *transverse-median vein* and is bordered behind by the *anal vein*. In *Psithyrus* and the subgenus *Bombus*, the transverse median vein is nearly straight and forms a strongly acute inner angle with the median vein and a strongly obtuse inner angle with the anal vein. In *Bombias*, the transverse median vein is usually curved from end to end and forms nearly a right angle with both the median and the anal veins (fig. 15). The radial cell is open and is separated from the median by the radial vein. The limits of the single cubital and first and second discoidal cells

are only indicated by the folds in the membrane of the wing. There is a deep and sharp indentation in the hind margin of the wing, called in this paper, the *sinus*. A fold connects this indentation with the end of the anal vein and divides the open anal cell or lobe from the second discoidal cell.

Legs.—The legs are moderately long and stout. The front pair are the smallest and the hind pair the largest. The coxæ, trochanters and femora are not armed with spines, but they all bear more or less pile. The fore and middle tibiæ of the female usually have very slender spines on their outer sides and on their distal ends, but in the males these spines are largely replaced by hairs. All the tibiæ bear considerable long hair. All of the five tarsal segments are more or less spiny. The basal one is much longer and larger than any of the others and is known as the metatarsus. This segment is densely spinose with slender spines over most of its inner face and along its front margin. It also has numerous spines on its distal end. All the metatarsi of the females are usually considerably spiny on their outer faces, but in the males these spines are largely replaced by hairs. The spines on the other tarsal segments are almost entirely confined to their distal ends and their lower sides.

The fore coxæ have their insertions between the posterior end of the prosternum and pro-episternum in front and the extension of the pronotum behind. They are flattened, triangular pieces and are somewhat convex, coarsely punctate, and hairy in front. Behind they are smoother and with but little hair. Their outer sides are excavated longitudinally for the reception of the trochanter and the base of the femur when these are drawn upward. The trochanter is well developed and grows gradually wider and becomes flattened from its base to its distal end where it joins the base of the femur with a slanting joint. It is very hairy on its lower side. The front femur is largest at its proximal and smallest at its distal end. It is very hairy on its lower side. The fore tibia is the only tibial segment of all the legs which is much shorter than the femur. It enlarges gradually from base to apex and, in the females, bears numerous spines on

its front side, especially toward the distal end. It is slightly excavated longitudinally, on the inner side, for contact with the femur when the leg is retracted. At its apex, on the inner side, is a long and much modified spine (fig. 20, SS), which is denticulated or spinulate on both edges of its distal half. This spine is movable and it covers a deep, fringed excavation on the inner side of the base of the metatarsus, forming an opening through which the antenna may be drawn and cleaned. This combined structure is, therefore, known as the *antenna cleaner*. The spine or spur has a broad membraneous and hyaline extension on its inner side, which is not shown in the figure. The metatarsus is long and slender and, except for its basal excavation, is of nearly the same width throughout. The three segments following the metatarsus are shorter for their width in the fore tarsi than they are in the middle and hind tarsi. Each is slightly emarginate, apically in the middle, for the reception of the base of the one following it. The fifth segment is nearly as long as the three which precede it taken together. It is gradually widened from base to apex. At its tip is a pair of well developed, curved and deeply cleft claws, between which is a rather small *pulvillus* (fig. 26, PS). The pulvillus is densely covered with minute ferruginous hairs. Each claw bears a single very long slender spine on the lower side near its base. These two spines probably have a sensory function. The middle coxæ are elongate and cylindrical in form and are partly imbedded, sidewise, in the thorax. They are inserted between the lower plate of the metapleuron and the front plate of the metasternum behind and the lower part of the mesothoracic episternum and the mesosternum in front. Each of these coxæ bears some long hair, arranged in a single longitudinal line, on its outer side. The femora and tibiæ are of nearly equal length, the latter being a very little the shorter. Aside from these differences and the absence of a cleaning apparatus at the tip of the tibia and the more distinctly flattened metatarsi, the mesothoracic legs differ little from those of the prothorax. The second, third and fourth segments of their tarsi are, however, proportionately some-

what longer. The hind coxæ are very close together and are inserted between the lower plate of the metapleuron and the front plate of the metasternum in front and the hind plate of the metasternum behind. They are triangular, flattened pieces and they taper from base to apex. The trochanters and femora do not differ, in any very important respect, from those of the fore and middle legs. In *Bombus*, the hind tibiæ (fig. B) of the queens and workers are modified for pollen collecting. In this modification, they have become considerably widened apically and their outer faces have become flattened, destitute of clothing, except for a fringe of long hairs on the front and hind margins, and smooth, except for a faint reticulation, which is plainly visible with a good lens. These flattened outer surfaces of the tibiæ, together with their bordering fringes of long hairs, make up what are known as the *corbiculæ* or *pollen baskets* and the bordering fringes are, in this paper, called the *corbicular fringes*. The color of these fringes is usually quite constant within species limits and is, therefore, of much taxonomic value. In *Psithyrus* (fig. A), the outer faces of the hind tibiæ of both sexes are convex and hairy all over. In the females, however, the hair on the front and hind margins of these tibiæ is somewhat longer than that between so that there is often a slight suggestion of a corbicula. In the males of *Bombus*, there is usually a considerable corbicular development, though it is always more or less weak in comparison with that of the females. There is considerable variation in this regard between the males of the different species. Those of the *Terrestris* group have very well developed corbiculæ. In the *Borealis* group, the outer faces of the hind tibia of the males are longitudinally concaved.

Each hind tibia, in all groups and castes, bears two long and prominent spines on the front side of its distal end, the inner being the longer (fig. 48, SS). Each of these spines has two lines of denticles or spinules on one side running from base to apex. The surface of these spines is very finely reticulated.

In *Bombus*, the hind tibiæ of the queens and workers have

a comb of stout spines on the inner side on the apical border (fig. 12). This comb is absent in the males and in *Psithyrus* (fig. 48). In *Bombus*, it guards the pincer-like cleft between the tibia and metatarsus described below, and so forms a part of the structure called the "wax shears" or "pollen mill."

The hind metatarsi of the females of *Bombus* are always very broad. This is also true in some species of *Psithyrus*. In the males of both genera, they are comparatively narrow. In both genera and both sexes, this segment is covered on the inner side with a brush of thickly set, slender and apically directed spines. By means of this brush and a similar one, present in both sexes on the inner side of the metatarsus of the middle leg, the bees gather the pollen from their bodies, since they often become covered with this dust from the flowers they visit. When *Bombus* queens or workers have gathered enough pollen on these brushes, it is scraped off from each over the edge of the tibia of the opposite hind leg and is thus stored in the corbiculæ. In this way a large ball of pollen accumulates in each pollen basket. It is probable that the males of *Bombus* and both sexes of *Psithyrus* use these brushes to clean their bodies and then clean the brushes themselves by rubbing them together. On the posterior side of the base of the hind metatarsus of the queens and workers of *Bombus* there is a prominent and pointed extension. This extension fits against the somewhat excavated apex of the tibia and forms with it a sort of pincer-like cleft. The function of this structure is not certainly known. It has been called the "wax shears" in the case of the honey bee, as it was supposed to be used for picking the plates of wax out of the wax pockets of the abdominal segments. They can hardly have this function in *Bombus*, as the species of this genus apparently secrete but little, if any, wax. It has been stated that they make honey pots of wax and that, in some cases, they also build a sort of wax roof over the brood cells. The writer has never observed the wax roofing, but the honey pots are common. As far as the writer has been able to determine, however, the honey pots are not made of wax,

but are constructed of pollen grains held together by some sort of glue, or cement. This cement may be propolis. It is interesting, in this connection, to note that Snodgrass, in his paper on the anatomy of the honey bee, states that he "has watched the bees take the wax from their abdomen and, in these observations, they always poked the wax plates loose with the ordinary hairs or spines of the tibiæ or tarsi and then, by means of the feet, passed them forward beneath the body."

In the opinion of the writer, Kirby came the nearest to suggesting the true function of these "wax shears," when he supposed them to be used in preparing the pollen masses borne by the corbiculæ. Some of the pollen appears to be scraped off from the spinous brushes, on the inner faces of the middle and hind matatarsi, by the comb of stout spines on the distal end of the hind tibia of the opposite side. This comb guides the pollen into the cleft, above described, between the tibia and the metatarsus. The crushing of the pollen grains in this cleft, which may, perhaps, be appropriately called the *pollen mill*, probably provides the viscid fluid necessary for holding the rest of the pollen together in the balls which are formed on the outer faces of the hind tibiæ.

Neither *Psithyrus* nor the males of *Bombus* have any noticeable posterior basal extension on their hind metatarsi (fig. K shows this extension of the *Bombus* queens, while fig. I shows the lack of it in the *Psithyrus* females).

In the males, the length of the hairs, borne on the hind borders of the posterior metatarsi, varies greatly between the different species. This comparative length is very constant within species limits and also, to a greater or less extent, within group limits. It is, therefore, of much value in classification. This hairy fringe is always long in the males of *Psithyrus* and of *Bombias* and of the *Kirbyellus* group. It is always short in the males of the *Borealis*, *Dumoucheli* and *Terrestris* groups. In the *Pratorum* group, it is variable. In the females of all *Bombus* groups, this fringe is rather long toward the base of the metatarsus, but rather short

toward its apex. In *Psithyrus* females, this fringe is rather long throughout the length of the metatarsus. The hind metatarsi, in all groups and castes, are proportionately much shorter, in comparison with the tibiæ, than are those of the front and middle legs. In *Bombus* males and in *Psithyrus*, the hind metatarsi vary considerably in the proportion of their length to their breadth and this variation is of some value in classification. The outer face of the hind metatarsus of the male is usually longitudinally concaved, but in a very few species (e. g.—*fraternus*) it is flat.

The segments of the hind tarsi, beyond the metatarsi, are not different from those of the front and middle tarsi in any important respect, except that they are proportionately longer.

Secondary Sexual Characters.

Aside from the presence of a sting in the females and of copulatory organs in the males, the following important sexual distinctions, which are common to the two genera, may be mentioned:

1. The males have thirteen segments in the antennæ while the females have only twelve. The segments of the flagellum are generally longer in the males and its basal segments are often of different relative length from what they are in the female.

2. The males have seven exposed abdominal segments while the females have only six.

3. The mandibles of the male are narrow and always two toothed while those of the female are broad and either without teeth or with three or more teeth.

4. The mandible of the male is heavily bearded on the outer side, while that of the female is not.

5. The labrum of the female has either tubercles or tubercular areas with a transverse, shelf-like projection or carina between them. These elevations are absent on the labrum of the male.

6. The epipygium and hypopygium of the female are pointed apically, while those of the male are rounded.

7. The coloration of the pile is markedly different in the males of some species from what it is in the females.

8. The male clypeus, as a rule, is very much more covered with hair than that of the female.

Besides the above described secondary sexual distinctions, *Bombus* and *Psithyrus* have certain such characters which are

peculiar to each genus. These will here be described separately :

Bombus.—(a). The females (queens and workers) have completely developed pollen baskets on the outer sides of the hind tibiæ while the males, as a rule, have them only partly developed.

(b). The hind leg of the female has a comb of spines on the inner side of the apical margin of the tibia, guarding a pincer-like cleft, formed between the end of the tibia and a posterior basal extension of the metatarsus. These structures, which make up the "pollen mills," are absent in the male.

(c). The eyes of the males of some species are greatly swollen and bulge out from the sides of the head as they never do in the females.

(d.) The malar space of the male is, in some species, much shorter than that of the female.

(e). The hind metatarsi of the females are much wider than those of the male and, in some species, have much shorter hair fringing the hind border.

(f). The queens are always larger than either the workers or males. The size of the males and workers is very variable and the variation has about the same range in each sex.

Psithyrus.—(a). The labrum of the females is triangular, that of the males rectangular.

(b). The hypopygium of the female has lateral elevations while that of the male does not have them.

Constancy of Characters.

In systematic work on any group of insects, a knowledge of the relative constancy of the various characters presented by the group is always of great assistance. In the family Bombidæ, all the structural characters, except the "malar space," appear to be very constant indeed within species limits and some of these characters, which are of great value in separating the species into natural groups, show only slight variation even within group limits. While the malar space, as a rule, varies but very little in proportional length between individuals of the same sex of the same species, its variation in some species is very considerable. As examples of species showing this variation we may cite *B. vagans* and *B. pleuralis.* Tables showing this variation have been included with the descriptions of these species.

The coloration of the pile is very much less constant be-

tween individuals of the same sex and species than are the structural characters and it is, therefore, less reliable in the determination of species. The coloration is much more constant on some parts of the body than it is on others. The following list is arranged to indicate, in a general way, the relative coloration constancy of the different parts of the body which present color characters much used in the classification of species in this paper. In this list, each part mentioned is, in the writer's opinion, usually more constant in its coloration within sex, or caste, and species limits than is the next following part:

(a). The hairy fringes on the front and hind borders of the hind tibiæ (the corbicular fringes of *Bombus*).

(b). The face and occiput of the head and the front part of the dorsum of the thorax.

(c). The hind trochanters and femora.

(d). The portion of the dorsum of the thorax between the bases of the wings.

(e). The mesopleura.

(f). The scutellum.

(g). The dorsum of the abdomen. Of this part, the apical portion is, in very variable species, much more constant in its coloration than are the middle and basal portions, and the basal portion is usually distinctly more constant than the middle portion.

Melanism.

The writer has never seen or heard of a true albino bumble-bee. Melanic specimens, however, though rare, are occasionally found. The writer has seen three such specimens. Two of them were queens of *B. pennsylvanicus* and the other was a queen of *B. auricomus*. In all these specimens, the pile that is usually yellow was very much darkened and looked sooty, there being hardly a sufficiently strong trace of the yellow to make identification possible.

Freak Specimens.

Specimens having an aberrant coloration of pile are very common. This, together with the very great normal variation of some of the species, has been the cause of the very great confusion which has existed in the classification of the

species of this family. On account of the difficulties met in arranging the species, some have been led to think that hybrids are common. The writer has never yet seen a single specimen of this family which, in his opinion, was a hybrid. Sufficiently thorough examination will usually enable one, who is familiar with the various species, to determine accurately to what species an aberrant specimen belongs, if the specimen is in good condition. It is often impossible to determine specimens, which are in very poor condition, and males which are extremely aberrant sometimes cannot be identified. Some of the more common and striking abnormalities are here described.

Males of many species, particularly of the *Pratorum* group, frequently sport in such a way as to have practically all their pile yellow. The writer has seen males of *ternarius* and of *mixtus* in this condition and they never could have been identified had it not been for their characteristic antennæ.

The writer has before him two queens of *bimaculatus* both of which were collected in Amherst, Mass., which have sported, in a peculiar way, in the coloration of the pile on the dorsum of the abdomen. One of these specimens has a patch of white pile on the second segment extending over the whole left side of the segment from the middle line to the side margin and another patch of the same color on the fourth segment extending from the middle line to the right side margin and from the front to the hind margin of the segment. The other specimen has a yellowish-white patch on the right side of the fourth segment of the same size and limits as the patch similarly located on the first specimen, but it has no abnormal coloration on the second segment.

Mimicry.

Numerous species of flies, of the family Syrphidæ, are much like bumble-bees in their appearance, as they have a covering of yellow and black pile. Some species also have some ferruginous hairs as do many species of *Bombus*. A few species of this family approach some species of *Bombus*, pretty definitely in their coloration and it seems fair to sup-

pose that possibly they are, to some extent, cases of protective imitation. Flies are probably captured by birds in large numbers, but, while bees are occasionally destroyed by the same enemies, they are probably attacked much less freely by them on account of their ability to sting. For this reason, it would be an advantage to any species of fly, if it resembled a bee closely in superficial appearance, as, on account of the resemblance, it would also be less attacked by the birds. Natural selection has doubtless brought about a close resemblance in many cases partly because of this advantage.

The best examples of fly resemblance of Bombidæ are presented by various species of the family Asilidæ. These examples are numerous and only the few following ones need be specifically mentioned here :

1. *Mallophora ruficauda* resembles *Bombus emiliæ* strikingly. These species are both present in southern Brazil.

2. *Mallophora tibialis* and *Eucritosia rubriventris* both resemble *Bombus carolinus* considerably and they probably range in habitat, to a considerable extent, in common with that species in the northern part of South America.

3. *Dasyllis thoracica* Fabricius, *D. affinis* Macquart, *D. tergissa* (var.) and *D. flavicollis* Say all resemble, more or less strongly, *Bombus impatiens* and *Psithyrus laboriosus*. All these Asilid species have their habitats within the ranges of the bee species which they resemble.

4. *Mallophora orcina* Wiedemann resembles the females of *Bombus pennsylvanicus* very strikingly. These two species range together in the southeastern United States.

5. *Dasyllis sacrator* Walker resembles *Bombus vagans* and *B. perplexus* very much in coloration and it ranges with these species in the northeastern United States and in southeastern Canada.

6. *Dasyllis astur* O. S. resembles *Bombus californicus* and *B. vosnesenskii* considerably and it ranges with those species in the Pacific Coast States.

7. *Dasyllis posticata* Say resembles *Bombus fervidus* females considerably and it has much the same widely extended habitat as has that species.

Bumble-bees are captured and devoured by Asilids in considerable numbers. The writer has many times found a partly eaten bumble-bee in the grasp of one of these flies; and, in every case, the fly and bee were of very similar colora-

tion. It seems possible that the fly is enabled to more easily approach and capture its bee prey because of this similarity. Moreover, the larvæ of many of the Syrphidæ, which resemble bumble-bees in their coloration, are reared in the nests and fed on the larvæ of these bees. It is supposed that, because of their resemblance, these flies are better able to enter the nests of the bees and lay their eggs in them. It seems probable, therefore, that with the families Asilidæ and Syrphidæ, two factors have worked together in guiding natural selection in bringing about the color resemblances of certain of their species to bumble-bee species.

These factors are:

(a). The advantage of *protective mimicry* already discussed, and
(b). The advantage of *aggressive mimicry*.

The bumble-bee hawk moth, *Hemaris diffinis* Boisduval, resembles bumble-bees a great deal in general appearance and may be a case of protective mimicry.

Many of the species of *Psithyrus* appear to imitate, in their coloration, the species of *Bombus* in the nests of which they are inquilines. This mimicry is probably entirely aggressive.

Species and Subspecies Limits.

Many of the New World species of Bombidæ, as they are considered in this paper, are so distinct from all others that they can hardly, at least with our present knowledge of their variations, be considered by any one as being closely enough related to any other forms to raise any question as to their complete and separate species rank. With many other species, however, the relationships are evidently very close, the differences, while apparently constant, being so small that it must be entirely a matter of personal opinion whether they should be given full species rank or be considered as only subspecies. A list of species showing several such doubtful relationships is here included:

1. *Bombus appositus* and *B. distinguendus* Morawitz.
2. " *californicus*, *B. fervidus* and *B. sonomæ*.
3. " *pennsylvanicus* and *B. sonorus*.
4. " *terricola* and *B. occidentalis*.

5. *Bombus vagans*, *B. bolsteri* and *B. cockerelli.*
6. " *frigidus* and *B. couperi.*
7. " *flavifrons*, *B. centralis* and *B. pleuralis.*
8. " *sitkensis* and *B. ambiguus.*
9. " *melanopygus*, *B. sylvicola* and *B. gelidus.*
10. " *ephippiatus* and *B. pulcher.*
11. " *huntii* and *B. laticinctus.*
12. " *separatus* and *B. mormonorum.*
13. " *rufocinctus*, *B. mexicensis* and *B. henshawi.*

If some other worker on this family should reduce the thirty-one species here listed to thirteen, as indicated, the writer could present no very substantial reasons why they should not be so classified.

Where the variation of a species has made it necessary to describe several color gradations, the writer has, in most cases, designated those gradations as "*color variants*" and numbered them consecutively instead of giving them names. Most entomologists would probably have given these gradations names and ranked them either as varieties or as subspecies. As different gradations are often found together in the same nest, being the offspring of the same queen, it seems unreasonable to the writer to give them any particular rank and the term "color variant" has been chosen as the one which seems to the writer to most accurately express the relationship of the various gradations to each other. Criticisms of this method of disposing of these variations is expected, but the writer is willing to endure it for the sake of his opinions concerning the matter. If names for these variants seem necessary, other students of the group are, of course, at liberty to furnish them.

Arrangement of Specific Descriptions.

In this paper, the specific descriptions, within the various groups, have been arranged as far as it has been possible, to indicate the relative closeness of the relationship of the species to one another. Such an arrangement for the *Dumoucheli* and *Fraternus* groups has been far more difficult, and will be found much less reliable, than for the other groups. Of the other groups, the *Pratorum* group alone

has a sufficient number of species to make a consideration of the arrangement of their descriptions necessary here. In this group, most of the New World species can be easily and naturally separated into several more or less distinct subgroups, as follows:

Subgroup 1. *bimaculatus* and *impatiens*.
" 2. *ternarius*, *huntii*, *fernaldi*, *vosnesenskii*, *edwardsii*, *melanopygus*, *sylvicola* and *gelidus*.
" 3. *perplexus*, *vagans*, *cockerelli*, *bolsteri*, *couperi* and *frigidus*.
" 4. *pleuralis*, *flavifrons* and *centralis*.
" 5. *ambiguus*, *sitkensis*, *mixtus* and *alboanalis*.

Distinctive Characters of the Genus Bombus.

Females of two kinds, queens and workers, with mandibles either three or four (exceptionally five or six) toothed (figs. 34, 36 and 37); labrum quadrangular in outline (fig. 107); abdomen, except apical segment, well covered with pile over practically the entire upper surface; ventral apical segment without lateral elevations (fig. C); posterior tibiæ with outer surface flat or slightly concave, naked, smooth and shining, fringed before and behind with long hairs forming a pollen basket (fig. B); end of each posterior tibia bearing, on the inner side, a transverse row of stout spines (fig. 12); each posterior metatarsus with a prominent projection or spur at the base on the posterior side (fig. J). Male with genitalia having corneus volsellæ and squamæ, and with anterior margin of labrum straight or incurved (fig. 51).

Part I.—SPECIES NORTH OF MEXICO.

Table for Separation of Queens of Bombus.

1. Occiput of head bearing light or yellow pile, or with a very strong admixture of light or yellow hairs..... 2.
Occiput of head black or with only a very slight admixture of yellow hairs.....60.
2. Hind femora and trochanters black..... 3.
Hind femora with considerable light pile, or the hind trochanters with light pile.....37.
3. Hairs fringing corbiculæ with a more or less distinctly ferruginous tinge ..... 4.
Hairs fringing corbiculæ black.....10.

4. Yellow pile of meso-pleura extending to bases of legs ..... 5.
   Yellow pile of pleura not extending to bases of legs..... 7.
5. All dorsal abdominal segments beyond the first two entirely covered with black pile.....**ambiguus.**
   Apical segments of abdomen bearing more or less yellow, light or ferruginous pile..... 6.
6. Dorsum of thorax having a clouded appearance, the pile being of yellow and black hairs thoroughly mixed.....**sitkensis.**
   Black band between the wings at least fairly well defined. **frigidus.**
7. Malar space nearly or quite as long as it is wide at the apex..... 8.
   Malar space not nearly as long as it is wide at the apex; apical segments without white pile..... 9.
8. Some of the abdominal segments bearing considerable ferruginous-red pile; apical segments without white pile.....**gelidus.**
   None of the abdominal segments bearing ferruginous pile; apical segments covered above with white pile.....**alboanalis.**
9. Scutellum densely and entirely covered with yellow pile. **henshawi.**
   At most with only a touch of yellow on the scutellum. **occidentalis-nigroscutatus.**
10. Yellow pile of meso-pleura extending to bases of legs.....11.
    Yellow pile of pleura not extending to bases of legs.....21.
11. Thorax above entirely, or almost entirely, covered with yellow pile..12.
    Thorax with a large amount of black pile between the bases of the wings .....17.
12. Malar space distinctly longer than it is wide at the apex.....13.
    Malar space not distinctly longer than it is wide at the apex.....14.
13. Second dorsal abdominal segment usually entirely covered with yellow pile; always more than half covered with yellow pile. **vagans.**
    Second dorsal abdominal segment more than half covered with black pile.....**bimaculatus.**
14. Some of the abdominal segments beyond the second bearing other than black pile .....**rufocinctus.**
    None of the abdominal segments beyond the second bearing other than black pile..... .....15.
15. Ocelli large; lateral ones much nearer to the margins of the eyes than to each other.....**separatus.**
    Ocelli small; lateral ones not nearer to the margins of the eyes than to each other..... .....16.
16. Second abdominal segment above entirely or in part covered with yellow pile.....**vagans.**
    Second abdominal segment above bearing little or no pile of a color other than dark brown or black.....**impatiens.**

17. Pile long and loose; second abdominal segment above entirely covered with ferruginous-red pile; fourth and fifth abdominal segments covered with very light yellow pile.....**sylvicola.**
Pile not especially long and loose; second abdominal segment usually not covered entirely with ferruginous pile.....18.
18. Face with a conspicuous amount of yellow pile about the bases of the antennæ; scutellum with only a scanty posterior border of yellow pile.....**ambiguus.**
Face without a conspicuous amount of yellow pile about the bases of the antennæ; scutellum well covered with yellow pile..19.
19. Second dorsal abdominal segment entirely covered with yellow pile; mesocoxæ strongly and heavily tufted with yellow pile....98.
Second dorsal abdominal segment partly covered with black or ferruginous-red pile; mesocoxæ at most only slightly tufted with yellow pile.....20.
20. Malar space longer than it is wide at the apex.....**pleuralis.**
Malar space not longer than it is wide at the apex...**rufocinctus.**
21. Face covered with yellow pile.....22.
Face with little or no yellow pile .....26.
22. Clypeus impunctate; length of malar space about one-third the length of the eye..... .....23.
Clypeus more or less strongly punctured; length of malar space less than one-third the length of the eye.....24.
23. Front part of thorax above bearing white or very light yellow pile; first five segments of abdomen above bearing tawny yellow pile.....**appositus.**
Front part of thorax bearing tawny yellow pile; only the first four segments of the abdomen above bearing tawny yellow pile. **borealis.**
24. Only one dorsal abdominal segment covered with other than black pile .....**vosnesenskii.**
More than one dorsal abdominal segment covered with other than black pile .....25.
25. Fifth abdominal segment covered above with black pile...**huntii.**
Fifth abdominal segment not covered above with black pile. **occidentalis.**
26. Dorsum of thorax entirely covered with light or yellow pile; at most only a small black spot present on the disc between the bases of the wings .....27.
Dorsum of thorax not nearly entirely covered with light or yellow pile; either the entire posterior half black, or at least a very noticeable black spot or band between the bases of the wings .....30.
27. All dorsal abdominal segments beyond the second entirely covered with black pile .....**perplexus.**
Not all so covered.....28.

28. Usually large queens with very dark wings.....29.
Medium sized or small queens with comparatively light colored wings..... .....**rufocinctus.**
29. Dorsum of thorax wholly and densely covered with bright yellow pile.....**morrisoni.**
A small rounded spot in middle of dorsum of thorax dark and more or less bare.....**nevadensis.**
30. Apical segments of abdomen bearing white pile.....**alboanalis.**
Apical segments of abdomen not bearing white pile.....31.
31. First abdominal segment covered above entirely or for the most part with black pile.....32.
First abdominal segment for the most part covered above with light or yellow pile.....35.
32. Usually large queens with very dark wings.....33.
Medium sized or small queens with comparatively light colored wings.....**rufocinctus.**
33. Ocelli large, placed well below the supra-orbital line in the narrowest part of the front.....34.
Ocelli small, placed near the supra-orbital line.....**occidentalis.**
34. Scutellum with at least a slight mixing of yellow hairs with the black; apical segments of the abdomen without any ferruginous pile.....**auricomus.**
Scutellum always entirely black; apical abdominal segments usually bearing more or less dark ferruginous pile....**crotchii.**
35. Malar space longer than it is wide at the apex; pile long and loose..36.
Malar space not longer than it is wide at the apex; pile short and dense.....**rufocinctus.**
36. Some of the dorsal abdominal segments bearing a considerable amount of ferruginous-red pile; hypopygium without a median carina.....**gelidus.**
None of the abdominal segments bearing ferruginous pile above; hypopygium with a median carina.....**pleuralis.**
37. Hairs fringing corbiculæ with a more or less distinctly ferruginous tinge.....38.
Hairs fringing corbiculæ black.....49.
38. Yellow pile of pleura extending to bases of legs.....39.
Yellow pile of pleura not extending to bases of legs...**edwardsii.**
39. Face with little or no yellow pile about the bases of the antennæ..40.
Face with a large amount of yellow pile about the bases of the antennæ.....41.
40. Malar space distinctly more than one-third the length of the eye. **kirbyellus.**
Malar space not one-third the length of the eye.....**frigidus.**
41. Hypopygium with median carina on apical portion.....42.
Hypopygium without median carina.....46.

42. Dorsum of thorax clouded by a mixture of black and yellow pile..43.
Dorsum of thorax with a distinct black interalar band.....44.
43. Femora bearing some yellow pile.....**flavifrons.**
Femora bearing no yellow pile .....**ambiguus.**
44. Abdomen with some segments bearing ferruginous pile.
centralis.
Abdomen without segments bearing ferruginous pile .....45.
45. Third abdominal segment covered above with black pile.
ambiguus.
Third abdominal segment covered above with yellow pile.
centralis.
46. Second dorsal abdominal segment covered entirely or for the most part with ferruginous-red pile.....47.
Second dorsal abdominal segment not covered with ferruginous pile .....48.
47. Pile on anterior part of dorsum of thorax strongly clouded by the mixture of yellow and black hairs .....**melanopygus.**
Pile on anterior part of dorsum of thorax light yellow, with no black hairs mixed in.....**sylvicola.**
48. Malar space somewhat longer than it is wide at the apex.
sitkensis.
Malar space not longer than it is wide at the apex.....**mixtus.**
49. Abdomen with some segments bearing ferruginous-red pile.....50.
Abdomen with no segment bearing ferruginous-red pile.....53.
50. Dorsum of thorax and vertex of head with black and yellow pile mixed, giving a clouded effect; black band between wings not definite nor distinct.....**melanopygus.**
Front part of thorax above with very little or no black pile mixed with the yellow.....51.
51. Second segment of abdomen entirely covered with yellow pile above; fourth segment with more or less ferruginous-red pile above.....97.
Second segment of abdomen with more or less ferruginous-red or black pile above.....52.
52. Pile long and loose; face generally with a strong tuft of yellow between and below the bases of the antennæ.....**sylvicola.**
Pile short; face seldom with a strong yellow tuft as above.
rufocinctus.
53. Malar space distinctly shorter than its width at the apex.....54
Malar space not distinctly shorter than it width at the apex.....56.
54. Fourth abdominal segment covered with black pile.....55.
Fourth abdominal segment not entirely covered with black pile.
rufocinctus.
55. Ocelli below the supra-orbital line, in the narrowest part of the front; lateral ones nearer to the eyes than to each other.
mormonorum.

Ocelli small, placed near the supra-orbital line, above the narrowest part of the front; the lateral ones about equidistant from the eyes and from each other.....**vagans.**

56. With a very large black patch or band on dorsum of thorax between the wing bases.....57.

With at most only a small black patch in this location.....**vagans.**

57. Second abdominal segment bearing black pile above.....**fernaldi.**

Second abdominal segment bearing yellow pile above.....58.

58. Pile on scutellum distinctly darker than that on the front part of the thorax above.....**ambiguus.**

Pile on scutellum not darker than that on the front part of the thorax above.....59.

59. Malar space distinctly longer than its width at apex; face with a conspicuous amount of yellow pile about the bases of the antennæ.....**cockerelli.**

Malar space not distinctly longer than its width at the apex; face without a conspicuous amount of yellow pile.....**couperi.**

60. Hairs fringing corbiculæ with a more or less distinctly ferruginous tinge.....61.

Hairs fringing corbiculæ black or mostly so.....69.

61. Yellow pile of pleura extending to bases of legs.....**kirbyellus.**

Yellow pile not covering pleura to bases of legs.....62.

62. Apical segments of abdomen bearing white pile.....63.

Apical segments of abdomen not bearing white pile.....64.

63. Hairs fringing corbiculæ strongly ferruginous; face with a rather faint touch of yellow about and below the bases of the antennæ.....**occidentalis.**

Hairs fringing corbiculæ usually with only a slight tinge of ferruginous; face without a yellow touch.

terrestris var. **moderatus.**

64. Malar space longer than it is wide at the apex.....65.

Malar space not longer than it is wide at the apex.....68.

65. Pile short and dense; black pile covering a part or all of the dorsum of the second abdominal segment.....**californicus.**

Pile long and loose; second abdominal segment above entirely covered with yellow pile.....66.

66. Clypeus almost impunctate; very smooth and shining.....**polaris.**

Clypeus somewhat strongly punctate.....67.

67. Pleura almost entirely dark.....**kincaidii.**

Pleura light, except lower half.....**strenuus.**

68. Face usually with a noticeable touch of yellow; western, mostly Californian.....**occidentalis-nigroscutatus.**

Face usually without a noticeable touch of yellow; eastern.

terricola.

69. Yellow pile of pleura extending to bases of legs.....70.

Yellow pile of pleura not extending to bases of legs.....79.

70. Some segments of abdomen beyond the second bearing ferruginous-red or reddish pile.....71.
No segment of abdomen beyond the second bearing ferruginous-red or reddish pile.....72.
71. Malar space fully one-third the length of the eye.....**kirbyellus.**
Malar space not one-third the length of the eye.....**ternarius.**
72. No black interalar band.....73.
With a broad black band between the wings (not always sharply defined).....76.
73. Ocelli large, placed well below the supra-orbital line and in the narrowest part of the front; lateral ocelli nearer the margins of the eyes than to each other.....74.
Ocelli small, placed near the supra-orbital line, above the narrowest part of the front; lateral ocelli about equidistant from from the margins of the eyes and from each other.....75.
74. Hind femora bearing a strong touch of yellow hairs..
mormonorum.
Hind femora all black.....**separatus.**
75. Malar space longer than it is wide at the apex; first four abdominal segments entirely covered above with yellow pile.
fervidus var. **dorsalis.**
Malar space not longer than it is wide at the apex; not all the first four abdominal segments covered above with yellow pile.
affinis.
76. Malar space distinctly more than one-third as long as the eye.
kirbyellus.
Malar space not more than one-third as long as the eye.....77.
77. First four abdominal segments entirely covered above with yellow pile .....**fervidus.**
Not all the first four abdominal segments entirely covered above with yellow pile.....78.
78. Basal portion of abdomen above with a large median triangular black area; none of the apical segments bearing much yellow pile above.....**pleuralis.**
Basal portion of abdomen without a large median black area; preapical abdominal segment above largely covered with yellow pile .....99.
79. Pleura mostly covered with light pile.....80.
Pleura with light pile extending but a short distance below bases of wings.....87.
80. Ocelli large; below the supra-orbital line, in the narrowest part of the front; malar space very short, much shorter than broad.
fraternus.
Ocelli small, near the supra-orbital line, above the narrowest part of the front; malar space at least as long as broad.....81.

81. Dorsum of thorax entirely covered with yellow pile; no black interalar band ..... **fervidus** var. **dorsalis.**
Dorsum of thorax not entirely covered with yellow pile.....82.
82. Hypopygium with median carina on apical part..... **pleuralis.**
Hypopygium without median carina .....83.
83. All the first four segments of the abdomen above covered with yellow pile ..... **fervidus.**
Not all the first four segments of the abdomen above covered with yellow pile .....84.
84. The two apical abdominal segments black.....85.
The two apical abdominal segments bearing long loose pile with a more or less distinctly ferruginous-red tinge; wings light for a queen. Northern.....86.
85. Wings dark; second dorsal abdominal segment entirely, or for the most part, covered above with black pile. Western.
californicus.
Wings rather light; second dorsal abdominal segment entirely covered above with light or yellow pile. Northwestern.
kincaidii.
86. Clypeus smooth and shining, almost impunctate..... **polaris.**
Clypeus somewhat strongly punctate; third abdominal segment entirely and evenly covered above with yellow pile.
strenuus.
87. Only the first two abdominal segments above covered with other than black pile ..... **arcticus.**
Abdomen not so colored .....88.
88. Ocelli large, placed well below the supra-orbital line, in the narrowest part of the front.....89.
Ocelli small, placed near the supra-orbital line, above the narrowest part of the front.....90.
89. Dorsum of thorax almost entirely covered with light pile.
nevadensis.
Dorsum of thorax not nearly entirely covered with light pile.
auricomus.
90. Dorsum of thorax almost or entirely covered with light pile 91,
Dorsum of thorax not nearly entirely covered with light pile.....92.
91. Only the two apical abdominal segments covered with black pile.
fervidus var. **dorsalis.**
The three apical abdominal segments covered with black pile.
sonorus.
92. Apical segments of abdomen bearing white pile.
terristris moderatus.
Apical segments of abdomen not bearing white pile.....93.
93. Second and third abdominal segments entirely covered with yellow pile above.....94.
Second and third abdominal segments not both entirely covered with yellow pile above.....96.

94. Apical abdominal segments bearing more or less light yellow or ferruginous-yellow pile; malar space short, not one-fourth the length of the eye.....**terricola.**
Apical abdominal segments bearing little or no light pile; malar space at least one-fourth the length of the eye.....95.
95. Scutellum covered with dense yellow pile. Southwestern.
sonorus.
Scutellum usually dark, with only a very slight touch of yellow pile. Cosmopolitan.....**pennsylvanicus.**
96. Malar space fully one-third the length of the eye.....84.
Malar space less than one-third the length of the eye; fourth abdominal segment covered above with black pile.
occidentalis nigroscutatus.
97. Third abdominal segment covered with black pile above.
frigidus.
Third abdominal segment covered with ferruginous-red pile above.
centralis.
98. Apical abdominal segments bearing ferruginous pile above.
frigidus.
Apical abdominal segments bearing light or yellow pile above.
couperi.
99. Greater part of dorsum of thorax strongly shaded by the mixing of yellow and black hairs.....**bolsteri.**
Black interalar band fairly well defined, black and yellow hairs not mixed to any extent on the dorsum of the thorax.
couperi.

Table for Separation of Workers of Bombus.

1. Face with a considerable amount of light or yellow pile..... 2.
Face with very little or no yellow pile.....29.
2. Pleura, or at least their lower parts, covered with black pile or so shaded by the admixture of dark hairs as to be noticeably darker than the front part of the thorax above; yellow pile not reaching bases of legs..... 3.
Pleura covered with yellow pile to bases of legs.....11.
3. Scutellum with very little or no light or yellow pile ..... 5.
Scutellum with considerable light or yellow pile..... 4.
4. Abdomen with more or less ferruginous-red pile on some of the dorsal abdominal segments..... 6.
Abdomen with no ferruginous pile above..... 8.
5. Apical abdominal segments with white pile.....**occidentalis.**
Apical abdominal segments without white pile.....**vosnesenskii.**
6. Pile very long and loose.....**sylvicola.**
Pile not very long and loose..... 7.

7. Fringes of corbiculæ with a distinctly ferruginous tinge; black interalar band extending back on to the scutellum in a sharp V. **edwardsii.**
   Fringes of corbiculæ without a ferruginous tinge; black interalar band usually not very distinctly marked; never extending in a sharp V onto the scutellum.....**rufocinctus.**
8. Clypeus completely impunctate, smooth and shining, except corners.....10.
   Clypeus somewhat sparsely punctured over its entire surface..... 9.
9. First abdominal segment above covered chiefly with black pile. **occidentalis.**
   First abdominal segment above covered chiefly with light or yellow pile.....**edwardsii.**
10. The last two abdominal segments black above.....**borealis.**
    Only the last segment black above.....**appositus.**
11. Third and fourth dorsal abdominal segments entirely covered with black pile.....12.
    Third and fourth dorsal abdominal segments not both entirely covered with black pile.....18.
12. Fifth dorsal abdominal segment covered with yellow pile.....13.
    Fifth dorsal abdominal segment black above.....14.
13. Scutellum densely covered with bright yellow pile; fringes of corbiculæ usually black.....**cockerelli.**
    Scutellum generally darkly shaded; fringes of corbiculæ usually strongly tinged with ferruginous.....**sitkensis.**
14. Pile covering scutellum conspicuously darker than that covering the anterior part of the thorax above.....**ambiguus.**
    Pile covering scutellum not conspicuously darker than that covering the anterior part of the thorax above.....15.
15. Yellow pile on scutellum and on anterior part of thorax above with black hairs strongly intermixed.....**flavifrons.**
    Yellow pile on scutellum and on anterior part of thorax above without admixture of black hairs.....16.
16. Malar space longer than its width at the apex.....**pleuralis.**
    Malar space not longer than its width at the apex.....17.
17. A touch of yellow pile present on the lateral margins of the third abdominal segment.....**mormonorum.**
    No touch of yellow pile on lateral margins of third segment. **separatus.**
18. First four segments of the abdomen above all covered with yellow or tawny pile.....19.
    Not all the first four abdominal segments above covered with tawny or yellow pile.....20.
19. Last two abdominal segments black; clypeus more or less punctate. **centralis.**

Only the apical abdominal segment black; clypeus smooth and shining ..... **appositus.**

20. Pile over the greater part of the thoracic dorsum of black and yellow hairs mixed, giving a clouded appearance.....21.

This pile not appearing clouded; black interalar band rather distinct .....24.

21. Pile on scutellum conspicuously lighter than that on any other part of the dorsum of the thorax..... **melanopygus.**

Pile on scutellum not conspicuously lighter than that on anterior part of the thorax above.....22.

22. The apical segments of abdomen covered above with light or ferruginous pile, or at least with such pile very strongly intermixed.....23.

The two apical segments of abdomen above not covered with light or ferruginous pile..... **flavifrons.**

23. Length of malar space greater than its breadth at the apex. **sitkensis.**

Malar space about as broad at the apex as it is long..... **mixtus.**

24. Pile very long and loose..... **sylvicola.**

Pile not very long and loose.....25.

25. Second dorsal abdominal segment entirely covered with yellow pile. **centralis.**

Second abdominal segment not entirely covered above with yellow pile .....26.

26. Yellow pile on face not very noticeable, sometimes entirely absent. **rufocinctus.**

Yellow pile on face very noticeable.....27.

27. Fringes of corbiculæ usually with a distinct ferruginous tinge; black interalar band extended posteriorly in the middle so as to divide or nearly divide the yellow of the scutellum. **edwardsii.**

Fringes of corbiculæ usually black and without a ferruginous tinge; posterior border of black interalar band running straight, or nearly so, across the thorax.....28.

28. Second and third abdominal segments with black pile above. **fernaldi.**

Second and third abdominal segments covered with yellow or ferruginous-red pile above..... **huntii.**

29. Pleura, or at least their lower parts, covered with black pile or so shaded by the admixture of dark hairs (*polaris* often excepted) as to be noticeably darker than the front part of the thorax above; yellow pile not reaching the bases of the legs..30.

Pleura covered with yellow pile to bases of legs.....31.

30. Dorsum of thorax entirely covered with yellow pile except, perhaps, a small dark spot in the center; no black interalar band.32.

The scutellum covered with black pile or else a black interalar band present.....33.

31. Not more than two dorsal abdominal segments covered to any extent with other than black pile.....34.

More than two abdominal segments covered entirely, or for the most part, with other than black pile.....35.

32. First four abdominal segments entirely covered above with yellow pile.....**fervidus** var. **dorsalis.**

Not all of these segments covered with yellow pile.....36.

33. Apical abdominal segments with white pile above.....41.

Apical abdominal segments without white pile above.....44.

34. Ocelli large; well below the supra-orbital line, in the narrowest part of the front; the lateral ones nearer to the margins of the eyes than to each other.....39.

Ocelli small; near the supra-orbital line; the lateral ones not nearer to the margins of the eyes than to each other.....40.

35. First four dorsal abdominal segments entirely covered with yellow pile; the apical segments without ferruginous pile.....57.

Either not all the first four dorsal abdominal segments are covered with yellow pile, or the apical segments bear considerable ferruginous-red or yellowish ferruginous pile, or both.....58.

36. Only two abdominal segments with yellow pile above; eastern. **perplexus.**

More than two of the dorsal abdominal segments with yellow pile; western.....37.

37. Malar space not longer than its width at the apex.....**morrisoni.**

Malar space longer than its width at the apex.....38.

38. Ocelli placed well below the supra-orbital line, in the narrowest part of the front.....**nevadensis.**

Ocelli placed near the supra-orbital line, above the narrowest part of the front.....**sonorus.**

39. Black interalar band present; malar space twice as wide at its apex as it is long.....**fraternus.**

No black interalar band present; malar space not twice as wide at its apex as it is long.....45.

40. Malar space as long as, or longer than, it is wide at its apex.....47.

Malar space wider at apex than it is long.....46.

41. Some of the abdominal segments covered above with ferruginous-red pile.....**sylvicola.**

None of the abdominal segments covered above with ferruginous pile.....42.

42. Fringes of corbiculæ with a distinct ferruginous tinge. **occidentalis.**

Fringes of corbiculæ black, with little or no ferruginous tinge...43.

43. First dorsal abdominal segment entirely covered with black pile; second segment entirely covered above with yellow pile. **terrestris** var. **moderatus.**

First abdominal segment entirely covered above with light or yellow pile; second segment not nearly entirely covered with yellow pile.....**alboanalis.**

44. Fourth and fifth abdominal segments both almost or entirely covered above with black pile.....48.

Fourth and fifth abdominal segments not both nearly covered with black pile.....49.

45. A touch of yellow pile present on the lateral margins of the third abdominal segment.....**mormonorum.**

No touch of yellow pile on lateral margins of third segment. **separatus.**

46. Disc of thorax with a central, dark, rather bare, shining area; basal middle of second dorsal abdominal segment usually bearing brown-ferruginous pile .....**affinis.**

Dorsum of thorax usually entirely covered with yellow pile; generally only the first dorsal abdominal segment bearing other than black pile.....**impatiens.**

47. A distinct black interalar band present.....50.

No black interalar band present.....56.

48. The first two abdominal segments, and only the first two, entirely covered above with yellow pile.....50.

Abdomen not so colored.....51.

49. Apical abdominal segments with ferruginous-red pile above.....60.

Apical abdominal segments without ferruginous-red pile above..62.

50. Hypopygium with median carina on its apical portion..**pleuralis.**

Hypopygium without median carina on its apical portion.....59.

51. Ocelli large; well below the supra-orbital line, in the narrowest part of the front.....52.

Ocelli small; near the supra-orbital line .....53.

52. Third dorsal abdominal segment entirely covered with yellow pile. **auricomus.**

Third segment not thus covered.....**crotchii.**

53. Malar space very short, not one-fourth the length of the eye.....54.

Malar space fully one-fourth the length of the eye.....55.

54. Eastern .....**terricola.**

Western, mostly Californian..**occidentalis** var. **nigroscutatus.**

55. Scutellum usually dark, with very little or no yellow pile (exceptionally, well covered with yellow pile); cosmopolitan. **pennsylvanicus.**

Scutellum always well covered with yellow pile; southwestern. **sonorus.**

56. Hypopygium with a median carina on its apical portion..**vagans.**

Hypopygium with no median carina.....**bimaculatus.**

57. Black interalar band present.....**fervidus.**

No black interalar band present.....**fervidus** var. **dorsalis.**

58. Greater part of dorsum of thorax with yellow and black hairs intermixed giving it a strongly clouded appearance .....65.
Black interalar band more or less distinct.....67.
59. Pile on third dorsal abdominal segment entirely or almost entirely black .....**arcticus.**
Pile on third segment more or less strongly yellow.....**kincaidii.**
60. Ocelli large; well below the supra-orbital line, in the narrowest part of the front .....**crotchii.**
Ocelli small; near the supra-orbital line..... .....61.
61. Occiput with more or less yellow pile; third abdominal segment entirely covered above with black pile; malar space not one-third as long as the eye.....**frigidus.**
Occiput black; third abdominal segment not entirely covered above with black pile; malar space one-third as long as the eye.
polaris.
62. Pile long and loose; some of the dorsal abdominal segments ferruginous-red.....79.
Pile not long and loose; none of the dorsal abdominal segments ferruginous.....63.
63. All the first four abdominal segments covered above with yellow pile .....**fervidus.**
Not all the first four abdominal segments entirely so covered....64.
64. Malar space much longer than it is wide at its apex.
californicus.
Malar space not much longer than it is wide at its apex.
occidentalis var. **nigroscutatus.**
65. Apical abdominal segment dark.... .....**cockerelli.**
Apical abdominal segment ferruginous-red or yellowish-ferruginous.....66.
66. Length of malar space greater than its width at the apex.
sitkensis.
Malar space as wide at its apex as it is long.....**mixtus.**
67. Occiput bearing little or no yellow pile.....68.
Occiput yellow or with a strong admixture of yellow hairs.....70.
68. Malar space as long as or longer than its width at the apex.....69.
Malar space wider at apex than it is long.....78.
69. Third dorsal abdominal segment entirely covered with black pile..72.
Third dorsal abdominal segment not entirely covered with black pile .....73.
70. Apical abdominal segments bearing ferruginous-red pile.
frigidus.
Apical segments not bearing ferruginous pile.....71.
71. Second abdominal segment entirely yellow and third entirely black above .....**couperi.**
Not so colored.....76.

72. Pile on abdomen long and loose; that on pleura tending to be whitish; malar space fully one-third the length of the eye. **kirbyellus.**
Pile not especially long and loose on abdomen; that on pleura yellow; malar space not one-third the length of the eye.....77.
73. Second and third dorsal abdominal segments covered with ferruginous-red pile..... **gelidus.**
Second and third segments not so covered.....74.
74. Middle portion of third abdominal segment above bearing considerable light pile, being sometimes entirely covered with it.....75.
Third dorsal abdominal segment bearing other than black pile only near the lateral margins..... **kirbyellus.**
75. Apical abdominal segments bearing more or less reddish-ferruginous pile..... **polaris.**
Apical segments not bearing reddish pile..... **kincaidii.**
76. Malar space as long as its width at the apex..... **gelidus.**
Malar space not as long as its width at the apex..... **rufocinctus.**
77. Dorsum of thorax clouded by a thorough mixing of the yellow and black pile..... **bolsteri.**
Dorsum of thorax not with clouded pile; interalar band distinct. **couperi.**
78. Abdomen with a large amount of ferruginous-red pile above. **ternarius.**
Abdomen with no ferruginous pile..... **couperi.**
79. The second dorsal abdominal segment clothed with ferruginous-red pile..... **sylvicola.**
The second segment without ferruginous pile..... **pleuralis.**

Table for Separation of Males of Bombus.

1. Eyes much swollen, bulging out from sides of head; ocelli placed well below the supra-orbital line; malar space short..... 2.
Eyes not bulging noticeably; ocelli near supra-orbital line.....13.
2. Pleura bearing yellow pile nearly or quite to bases of legs..... 3.
Pleura with yellow pile not nearly reaching bases of legs.....4.
3. More than two dorsal segments of the abdomen covered with yellow pile.....6.
Not more than two of the abdominal segments thus covered..... 7.
4. Hind femora with little or no light or yellow pile..... **crotchii.**
Hind femora with considerable light or yellow pile..... 5.
5. Last three abdominal segments entirely covered with black pile. **morrisoni.**
Not all of the last three segments so covered..... **rufocinctus.**
6. Third antennal segment as long as segments four and five together.....12.

Third antennal segment equalling segment five.....**rufocinctus.**

7. Malar space a mere transverse line.....**fraternus.**
   Malar space one-third as long as wide..... 8.
8. All the dorsal abdominal segments beyond the second entirely covered with black pile..... 9.
   Not all the segments beyond the second so covered .....10.
9. The second dorsal abdominal segment entirely covered with pile of a color other than black.....11.
   The second dorsal segment partly covered with black pile. **separatus.**
10. Third antennal segment as long as segments four and five together.....**auricomus.**
    Third antennal segment equalling segment five.....**rufocinctus.**
11. Distance between the inner margins of the eyes distinctly greater than the width of either eye.....**rufocinctus.**
    Distance between the inner margins of the eyes about equal to the width of either eye.....**mormonorum.**
12. Apical segments of abdomen with dull ferruginous yellow pile; western .....**nevadensis.**
    Apical segments of abdomen with black pile; mostly eastern. **auricomus.**
13. Hairs fringing hind tibiæ on the outer surface with a more or less distinctly light or ferruginous tinge.....14.
    These hairs entirely or almost entirely black.....15.
14. Hind femora with little or no light or yellow pile.....16.
    Hind femora with considerable light or yellow pile.....18.
15. Pleura clothed with yellow or light pile from wing bases to bases of legs.....21.
    Pleura clothed largely with dark pile.....22.
16. Second dorsal abdominal segment entirely covered with yellow pile .....37.
    Second dorsal segment seldom entirely covered with yellow pile; western .....17.
17. Apical abdominal segments usually covered with white pile, without a distinct ferruginous tinge; third dorsal abdominal segment usually not entirely covered with yellow pile. **occidentalis.**
    Light pile on apical abdominal segments usually with a distinct ferruginous-red tinge; third dorsal abdominal segment entirely covered with yellow pile; mostly Californian. **occidentalis-nigroscutatus.**
18. Malar space fully one-half as long as the eye.....19.
    Malar space not one-half as long as the eye.....20.
19. Pleura usually heavily shaded, darker than anterior part of dorsum of thorax.....**kincaidii.**

Pleura not shaded, as light as anterior part of thoracic dorsum; three apical segments largely covered with light yellow (or ferruginous-red) pile ..... **kirbyellus.**

20. Pleura black or strongly shaded by admixture of dark hairs, which usually predominate ..... 23.

Pleura not strongly shaded by admixture of dark hairs; not noticeably darker than anterior part of thorax above ..... 24.

21. Occiput with very little or no light or yellow pile ..... 39.

Occiput with considerable light or yellow pile ..... 40.

22. First four dorsal segments of the abdomen covered with tawny or yellow pile ..... 33.

Not all the first four segments thus covered ..... 35.

23. First two dorsal abdominal segments entirely covered with yellow pile; apical segments with rather long, loose pile ..... 25.

First two dorsal abdominal segments not both entirely covered with yellow pile; pile of apical segments rather short and dense ..... 17.

24. Second dorsal abdominal segment entirely covered with yellow pile ..... 27.

Second abdominal segment wholly or partly covered with black or ferruginous pile ..... 28.

25. Posterior metatarsi with long, loose hairs on hind margin ..... 26.

Posterior metatarsi not with long hairs on posterior margin. **pennsylvanicus.**

26. Sides of head behind the eyes with little or no light or yellow pile. **strenuus.**

Sides of head behind the eyes with considerable light or yellow pile ..... **polaris.**

27. Third and fourth dorsal abdominal segments entirely covered with ferruginous-red pile ..... **flavifrons** and **centralis.**

Third and fourth dorsal abdominal segments not both entirely covered with ferruginous-red pile ..... 29.

28. Sides of head behind the eyes with very little or no light or yellow pile ..... 30.

Sides of head behind eyes with considerable light or yellow pile.. 32.

29. Third dorsal abdominal segment entirely covered with yellow pile ..... 46.

Third abdominal segment not entirely covered with yellow pile.. 48.

30. Second and third dorsal abdominal segments with ferruginous-red pile ..... 66.

Abdomen without ferruginous pile above ..... 31.

31. Apical dorsal abdominal segments covered with white pile. **occidentalis.**

Apical abdominal segments not bearing white pile..... **impatiens.**

32. Black interalar band present ..... 51.

Black interalar band absent ..... 52.

33. Outer surface of hind tibiæ concaved ..... **borealis.**
Outer surface of hind tibiæ convex ..... 34.
34. Femora with considerable light pile ..... **pennsylvanicus.**
Femora with little or no light pile ..... **sonorus.**
35. Greater part of face very densely covered with yellow pile with no admixture of black hairs ..... **vosnesenskii.**
Face not bearing a great amount of yellow pile, if any, what there is being mixed with black hairs ..... 36.
36. Malar space half as long as the eye ..... **arcticus.**
Malar space not nearly half the length of the eye ..... 37.
37. Third dorsal abdominal segment covered entirely, or for the most part, with black pile ..... 38.
Third dorsal segment covered with yellow pile ..... **terricola.**
38. Apical abdominal segments with white pile.
terrestris var. **moderatus.**
Apical abdominal segments with no white pile ..... **californicus.**
39. Apex of abdomen usually bearing a considerable amount of dull ferruginous-red pile ; some of the tibiæ usually more or less distinctly fringed with ferruginous hairs ; pile of scutellum often, but not always, with a very strong admixture of black hairs ..... **pennsylvanicus.**
Apex of abdomen always black ; all of the tibiæ black, except the posterior ones on the inside ; pile of scutellum never with a strong admixture of black hairs ..... **fervidus.**
Third dorsal abdominal segment black ; scutellum mostly yellow.
affinis.
40. Third or fourth dorsal abdominal segment entirely covered with black pile ..... 41.
Neither the third nor the fourth dorsal abdominal segment thus covered ..... 43.
41. Abdomen without yellow pile above except on the first segment.
impatiens.
Abdomen with more or less yellow pile on other segments than the first above ..... 42.
42. Second dorsal abdominal segment bearing considerable black pile, especially on the sides, and usually on the apical half also (all black in case of *californicus*) ..... 54.
Abdomen having little or no black pile on the second dorsal segment ..... 56.
43. Hind metatarsi with long hairs ..... 44.
Hind metatarsi without long hairs ..... **appositus.**
44. Some of the dorsal abdominal segments covered with ferruginous-red pile ..... 45.
None of the dorsal abdominal segments so covered ..... **perplexus.**
45. Second dorsal abdominal segment covered with yellow pile.
flavifrons and **centralis.**

Second segment covered with ferruginous-red pile.
melanopygus.

46. Black interalar band more or less distinct.....47.
No trace of black interalar band.....**perplexus.**
47. Posterior border of hind metatarsi fringed with long, loose hairs.
polaris.
Posterior border of hind metatarsi fringed with short hairs or bristles .....**pennsylvanicus.**
48. All the dorsal abdominal segments after the first two entirely covered with black pile .....49.
Not all the posterior dorsal abdominal segments entirely covered with black pile.....50.
49. Distinct black interalar band present; western.....**pleuralis.**
No distinct black interalar band; eastern .....**vagans.**
50. Black interalar band more or less distinct; yellow spot of pile on face, when present, not nearly reaching the margin of the eye on either side.....58.
Black interalar band not at all distinct, the middle of the dorsum of the thorax having only a clouded appearance due to the thorough mixture of yellow and black hairs; yellow pile on face very nearly reaching the inner margin of the eye on each side..... .....60.
51. Black interalar band extended behind into a distinct V on the middle of the scutellum.....61.
Posterior border of interalar band straight or nearly so .....63.
52. First dorsal abdominal segment covered for the most part with black pile.....**occidentalis.**
First dorsal segment entirely covered with yellow pile.....53.
53. Some of the dorsal abdominal segments covered with ferruginous-red pile.....**melanopygus.**
None of these segments covered with ferruginous pile..**impatiens.**
54. Some of the apical dorsal abdominal segments covered with yellow pile .....55.
None of the apical dorsal abdominal segments covered with yellow pile.....**bimaculatus.**
55. Scutellum and basal abdominal segment above yellow...**fernaldi.**
Scutellum and basal abdominal segment above black.
californicus.
56. Face with a strong touch of yellow pile about and below the bases of the antennæ .....57.
Face with very little or no light pile.....**affinis.**
57. Third dorsal abdominal segment black.....**vagans.**
Third dorsal segment yellow.....**perplexus.**
58. Third dorsal abdominal segment with little or no yellow pile; colors (ferruginous, yellow and black) usually strong and sharply defined; body rather slender .....**frigidus.**

Third dorsal abdominal segment with a considerable amount of yellow pile especially on apical half ..... 59.

59. Body rather slender; pile short and dense; western. **californicus.**

Body more robust; pile long and loose; colors (ferruginous, yellow and black) neither strong nor sharply defined; northern. **polaris.**

60. Each of the first two segments of the flagellum of the antenna bearing a noticeable tuft of hairs on the outer side. **mixtus.**

These segments without tufts of hair..... **sitkensis.**

61. Basal portion of flagellum of antenna, when viewed laterally, appearing strongly crenate below; fourth antennal segment as long as the third; eastern ..... **ternarius.**

Basal portion of flagellum not appearing strongly crenate when viewed laterally; third antennal segment slightly longer than fourth; western..... 62.

62. Yellow pile on face and on anterior portion of thorax above strongly mixed with black hairs..... **melanopygus.**

Yellow pile on these regions with few or no black hairs intermixed. **edwardsii.**

63. Abdomen with some segments bearing ferruginous-red pile..... 67.

Abdomen with no segment bearing ferruginous pile..... 64.

64. Apical abdominal segments bearing white or whitish ferruginous pile..... **occidentalis.**

Apical abdominal segments not bearing white or whitish ferruginous pile ..... 65.

65. Face nearly covered with yellow pile..... **fernaldi.**

Face without a great amount of yellow pile..... **californicus.**

66. Colors (yellow, ferruginous-red and black) bright and contrasting sharply ..... **sylvicola.**

Colors (yellow, ferruginous-red and black) dull, not contrasting sharply..... **gelidus.**

67. Front part of dorsum of thorax clouded by a mixture of yellow and black hair..... **melanopygus.**

Dorsum of thorax not so clouded in front..... **huntii.**

Subgenus **BOMBUS** Robertson (genus).

Bombus Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 176.

" Viereck et als., Can. Ent., XXXVI, 1904, p. 97.

" Viereck, Trans. Amer. Ent. Soc., XXXII, 1906, pp. 224 and 240.

" Swenk, Ent. News, XVIII, 1907, p. 295.

Subgenus *Bombus* Franklin, Trans. Amer Ent. Soc., XXXVII, 1911, p. 157.

Type.—Bombus (*Bombus*) *terrestris* (L.).

Distinctive Characters of the Subgenus.

Females and males (figs. E and F) with ocelli small, placed near the supra-orbital line and above the narrowest part of the vertex, the two lateral ones about as far from the margins of the eyes as from each other; fore wings with transverse median vein (fig. 3) forming an obtuse inner angle with the median and tending to coalesce at its base for a short distance with base of discoidal vein; hind wing (fig. 4) with transverse median vein nearly straight, forming a strongly acute inner angle with the median and a strongly obtuse inner angle with the anal vein.

Eyes of male not noticeably swollen; vertex broad, not depressed; malar space at least as long as its width at the apex; third antennal segment usually shorter than fifth; genitalia with volsellæ usually extending but little beyond the tips of the squamæ (some species of the *Dumoucheli* group are marked exceptions in this respect).

The apices of the hind metatarsi of the females usually drawn out into a more prominent projection, behind the insertion of the second tarsal segment, than in the subgenus *Bombias* (the species of the *Terrestris* group are notable exceptions), but into a less prominent projection than in *Psithyrus*.

The five following New World groups are placed in this subgenus: *Terrestris*, *Borealis*, *Kirbyellus*, *Pratorum* and *Dumoucheli*.

THE TERRESTRIS GROUP.

"The group of *B. terrestris*" Radoszkowski, Bull. Soc. natural. Moscow, xlix, P. 1, 1884, p. 80.

Type.—*Bombus terrestris* Linnæus.

Characters of the Group.

Females.—Head broad and rounded in outline; malar space short; mandibles strongly four-toothed; hypopygium without median carina; genital guides toothed; the posterior margins of the hind metatarsi unusually arcuate and their apices, behind the insertion of the second tarsal segment, not drawn out into so prominent a projection as in most of the species of the subgenus *Bombus*.

Males.—Antennæ of less than average length for *Bombus* males. Posterior tibia fringed with long hairs on anterior and posterior borders, forming a more or less strong carbicula. Hind metatarsi with hind fringes short or very moderate, never very long; their outer faces strongly concaved and with pubescence sparse and uneven.

Genitalia.—Outer spatha very short (front to rear) in comparison with its width—side to side—(fig. 111); anterior angles widely rounded; anterior margin widely, deeply, and evenly incurved; posterior margin broadly and rather evenly outcurved except on sides, where it appears to be more or less truncate; ventral surface, near posterior margin, bearing a tuft of rather long, loose hairs. Inner spatha (figs. 113 and 135) variable, not only for the group but for each species in it; always more or less deeply bifid at the apex and with a large fenestra near the middle; often with two or three smaller fenestræ toward the apex; apical margin pretty well covered with hair on ventral surface or nearly hairless; ventral surface somewhat reticulate. Each clasper (figs. 119 and 120) short, thick, and stubby; branch wide at the base but narrowing rapidly to an almost pointed apex as seen from either above or below. Volsella considerably hidden, except toward the apex, within the branch; considerably wider at the base than toward the apex, apex appearing very hairy and obliquely truncate and with a rather narrow recurved apical projection. Squama almost divided by a deep notch on the inner side; inner lobe triangular and pointed on inner side. Sagitta wide and flaring, with twisted shaft; head bluntly pointed at apex and with wide base, the margins being irregularly serrate.

Bombus (Bombus) terrestris var. **moderatus** Cress.

Bombus modestus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 99, n. 22, ♀ (not Smith).

" *moderatus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 109, n. 22.

" *terrestris* var. *ferrugineus* Schmiedeknecht, Jenaisch. Zeitschr. f. Naturw., XII, 1878, p. 359, ♀ ☿ ♂.

" *moderatus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).

Bombus terrestris var. *ferrugineus* Schmiedeknecht, Apid. Europ., I, p. 5, 1883, p. 381, n. 5, ♂.

" *moderatus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.

" *terrestris* var. *schmiedeknechti* Meunier, Natural. Sicil., VII, 1888, p. 174.

" *terricola* var. *modestus* Ant. Handlirsch, Ann naturh. Hofmus. Wien, III, 1888, p. 234.

" *terrestris* var. *ferrugineus* Dalla Torre, Cat. Hym., X, 1896, p. 557.

" *terricola* var. *modestus* Dalla Torre, Cat. Hym., X, 1896, 558.

" *moderatus* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 123; Hym. of Alaska, 1904, p. 129.

" *moderatus* Howard, Insect Book, 1904, Plate II, fig. 2.

" *terrestris* var. *moderatus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rept. Ent. Soc. Ont.), 1908, p. 111.

Type.—The queen is in the collection of the American Entomological Society.

Pile rather long and of medium texture. Head dark; anterior part of the dorsum of the thorax yellow, the remainder black; abdomen with first segment of dorsum black, the second yellow, the third and base of fourth black and the apical segments white; venter black; legs dark; wings subhyaline.

Queen. Head.—Entirely dark. Labrum with tubercle-like areas large and moderately separated, their summits deeply concaved and margins rather sharply elevated; shelf-like projection moderately wide and prominent. Malar space scarcely as long as its width at the apex, less than one-fifth as long as the eye. Clypeus rather coarsely punctate. Flagellum of antenna about one and three-quarters times as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer that the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile back to the tegulæ, this color usually extending down onto the mesopleura considerably below the bases of the wings and often even covering as much as the upper halves of the mesopleura; the remainder of the thorax black.

Abdomen.—Dorsum: segment one black; segment two yellow; segment three black; segment four with the basal portion black and the apical portion (sometimes only the apical margin and sometimes even more than the apical half) clothed with white or whitish pile; segment five entirely covered with white pile; segment six mostly dark, but usually with more or less white or whitish pile on the sides. Venter mostly black, but usually with more or less whitish pile on the sides of the apical margins of the apical segments.

Wings.—Only slightly stained with brown; the fore pair darkest in the region beyond the veins.

Legs.—Dark ; the corbicular fringes usually black, but often more or less strongly fulvo-ferruginous.

Worker.—Much like the queen ; rarely as much as the upper halves of the mesopleura covered with yellow pile.

Male.—Head.—Entirely dark. Malar space fully as long as its width at apex, about one-fourth as long as the eye. Clypeus pretty well covered up with pile. Third and fifth antennal segments subequal in length, the fourth shorter than either.

Thorax.—Colored like that of the females.

Abdomen.—Colored much like that of the females ; the apical dorsal segments entirely covered with white pile.

Wings.—About like those of the females.

Legs.—Mostly dark ; the hind coxæ and trochanters and the bases of the hind femora with considerable light pile ; the fore and middle tibiæ with considerable ferruginous pile on their hind sides ; posterior tibiæ with outer faces somewhat convex and naked, smooth and shining ; the corbicular fringes mostly dark, but rather strongly tinged with ferruginous ; posterior metatarsi with short hind fringes.

Dimensions.—Length : queen, 18 mm. to 20 mm. ; worker, 12 mm. to 15 mm. ; male, 16 mm. Spread of wings : queen, 39 mm. to 44 mm. ; worker, 24 mm. to 33 mm. ; male, 39 mm. Width of abdomen at second segment : queen, 9 mm. to 11 mm. ; worker, 6 mm. to $8\frac{1}{2}$ mm. ; male, $8\frac{1}{2}$ mm.

Redescribed from seven queens (two of them homotypes), ten workers and one male.

Habitat.—This form ranges throughout the greater part of Europe and Siberia. In the New World, it appears to be confined to Alaska, though it may possibly be found in the adjoining territory of Yukon. My Alaskan records are as follows : Point Barrow, Cosmos, Kukak Bay, Koyukuk and Kadiak. I also have records from Petropaulski, Kamchatka and Bering Island.

I have seen a large series of all three castes (in Museum of Comparative Zöology) of this form from Sweden and Bavaria. One of the males bore the label "*Bombus ferrugineus*" and the determination was by Gerstaecker. There is also a queen in the collection of the Massachusetts Agricultural College labelled "*Bombus terrestris* var. *ferrugineus*" by Schmiedeknecht.

Nests.—Schmiedeknecht says that *terrestris* generally has its nests under ground and that they often contain hundreds of individuals.

I have not examined the genitalia of the male of this species, but I am able to tell, from Radoszkowski's figures and Schmiedeknecht's description, that in general they resemble those of the other species which I have placed in the *Terrestris* group. Judging from Radoszkowski's figures they are scarcely separable from those of *occidentalis* and *terricola*.

Bombus (Bombus) occidentalis Greene.

Bombus occidentalis Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1858, p. 12, n. 2, ♀ ♂; Id., VII, 1860, p. 170, n. 3, ♀.
" *modestus* Smith, Journ. of Ent., I, 1861, p. 153, n. 4, ☿.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 98, n. 20, ♀ ☿ ♂.
" *proximus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 98, n. 21, ☿.
" *howardi* Cresson, Proc. Ent. Soc. Phila., II, 1863, 99, n. 24, ♂; *modestus*, Id. II, 1863, p. 109, n. 21–22, ♀.
" *occidentalis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *howardii* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *howardii* var. *proximus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *howardii* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *howardii* var. *proximus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *occidentalis* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *terricola* var. *howardii* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 234.
" *terricola* var. *proximus* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 234.
" *terricola* var. *occidentalis* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 234.
" *terricola* var. *howardii* Dalla Torre, Cat. Hym., X, 1896, p. 557.
" *terricola* var. *occidentalis* Dalla Torre, Cat. Hym., X, 1896, p. 557.
" *terricola* var. *proximus* Dalla Torre, Cat. Hym., X, 1896, p. 559.
" *howardi* Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
" *perixanthus* Cockerell and Porter, Ann. and Magaz. Nat. Hist.
" *howardi* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, Vol. IV, 1899, p. 389.

Bombus proximus Cockerell, Ann. and Magaz. Nat. Hist., Ser. 7, May, 1900, Article LIV.
" *proximus* Cockerell, Pysche, IX, 1901, p. 163—also *proximus* var. *howardi*.
" *occidentalis* Fowler, Rep't Cal. Agrl. Exp. Sta., 1902, Part II, p. 317.
? " *terricola* Titus, Can. Ent., XXXIV, 1902, p. 42.
" *proximus* var. *coloradensis* Titus, Can. Ent., XXXIV, 1902, pp. 38 and 41, ♀.
" *proximus* Titus, Can. Ent., XXXIV, 1902, pp. 38 and 41, ♀ ☿ ♂; also *Howardii*.
" *proximus* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 124.
" *mckayi* Ashmead, Proc. Wash. Ac. Sc., IV, 1902, p. 125.
" *howardi* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *proximus* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *occidentalis* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *proximus* Ashmead, Hym. of Alaska, 1904, p. 130.
" *mckayi* Ashmead, Hym. of Alaska, 1904, p. 131.
" *howardi* Viereck, Trans. Amer. Ent. Soc., July, 1906, p. 238.
" *proximus* Cockerell, Trans. Amer. Ent. Soc., XXXII, November, 1906, p. 313.
" *proximus perixanthus* Cockerell, Trans. Amer. Ent. Soc., XXXII, November, 1906, p. 313.
" *proximus howardi* Cockerell, Trans. Amer. Ent. Soc., XXXII, November, 1906, p. 313.
" *proximus coloradensis* Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 1.
" *proximus coloradensis* Cockerell, Univ. Color. Studies, IV, 1907, p. 258.
" *proximus* Cockerell, Univ. Color. Studies, IV, 1907, p. 258.
" *occidentalis* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.
" *nigroscutatus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Types.—The types of all Greene's species seem to have been lost. At least a part of them were alcoholic specimens and they were examined at one time by Mr. Cresson. When asked about them, Mr. Cresson told me that he did not know where they were unless they were in Boston. Prof. Johnson has been unable to find them for me in the collection of the Boston Society of Natural History and Mr. Henshaw has been unable to locate them in the collection of the Museum

of Comparative Zoölogy. I have placed Smith's *modestus* worker and *proximus coloradensis* Titus in the synonomy of this species entirely on the published descriptions. The type of *howardii* Cresson is in the collection of the American Entomological Society as are also specimens of *B. proximus* named by Cresson. I have examined the type specimen of *mckayi;* it is in very poor condition, but it can be plainly seen that it nearly corresponds for the queen to the *proximus* form of the worker. I consider *perixanthus* of Cockerell, a cotype of which I have examined, to be nearly typical *occidentalis*, as Greene's original description reads "first four abdominal segments black."

Pile of medium length and texture. Face with more or less yellow pile; occiput black in females, yellow in males; thorax variable, but the anterior part of the dorsum always covered with yellow pile; abdomen variable, always black at base and white or whitish-ferruginous at apex, black or yellow in the middle; wings rather light; legs dark, but the corbicular fringes more or less ferruginous.

Queen. Head.—Face bearing a somewhat variable mixture of black and yellowish-ferruginous pile; occiput and cheeks dark. Labrum with tubercle-like areas large and moderately well separated, their summits rather deeply concaved and their margins rather sharply elevated; the space between these areas and above the shelf-like projection rather deeply excavated; the shelf-like projection prominent and moderately wide. Malar space shorter than its width at apex; not more than one-fifth as long as the eye. Clypeus moderately punctate. Flagellum of antenna about one and three-fourths times as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile, the yellow usually extending down onto the mesopleura somewhat below the level of the bases of the wings; the remaining portion of the dorsum sometimes entirely black, sometimes with only a mixture of yellow hairs with the black on the scutellum, sometimes with the scutellum entirely yellow and a black band between the bases of the wings, and sometimes even this band nearly replaced by yellow pile, leaving only the disc dark; the disc naked, smooth and shining; mesopleura, except their very upper parts, covered with black pile to the bases of the legs; metapleura and sides of median segment entirely dark.

Abdomen.—Dorsum: segments one, two and three entirely black; segment four entirely black or black with a fringe of white hairs on its apical margin; segment five covered with white or whitish pile; segment six either entirely whitish or mostly black with white or whit-

ish hairs on the sides. Venter mostly black, but the apical margins of the apical segments fringed more or less with white or whitish hairs.

Wings.—Moderately stained with brown; the fore pair variable, but usually lightest across the middle and darkest about the anterior apical portion of the radial cell.

Legs.—Mostly dark; the middle tibiæ sometimes with a noticeable amount of ferruginous pile on their hind sides, especially toward their distal ends; corbicular fringes always more or less strongly ferruginous.

Worker.—Much like the queen, but the wings usually somewhat lighter; the scutellum at most with only a slight mixture of yellow hairs with the black; face usually mostly dark, without a very noticeable amount of yellowish-ferruginous pile, and often entirely dark.

Male. Head.—Shaped much like that of the females. Face bearing a large amount of yellowish pile, sometimes pure and sometimes mixed with black; mostly dark above the bases of the antennæ. Occiput sometimes with pure yellowish pile and sometimes with black hairs admixed. Ventro-lateral portions of head often with a noticeable amount of brownish yellow pile; the cheeks otherwise dark. Malar space longer than its width at apex; about one-fifth as long as the eye. Clypeus usually mostly covered up with pile. Flagellum of antenna about two and one-half times as long as the scape; third and fifth antennal segments subequal in length, the fourth shorter than either.

Thorax.—Coloration much as in the queen and with about the same variation, but the mesopleura often with the yellow pile extending down from the dorsum, in a rather narrow line, nearly to the bases of the legs and occasionally entirely covered with yellow pile to the bases of the legs.

Abdomen.—Dorsum: The first four segments entirely black; the last three entirely covered with white or whitish pile, often with a more or less strong ferruginous tinge. Venter colored much as in the females, but usually with somewhat more light pile.

Genitalia.—As already described for the group. See figs. 119 and 120.

Wings.—About as in the worker; subhyaline.

Legs.—Sometimes with little or no light pile, but the coxæ and trochanters usually, and the bases of the femora often, with considerable yellowish or brownish yellow pile on their lower sides and sometimes the femora largely clothed with light pile even to their tips; the hind sides of the middle tibiæ usually and often also the anterior tibiæ, bearing a considerable amount of ferruginous pile; outer faces of hind tibiæ slightly convex, naked, smooth and shining; the corbicular fringes usually strongly ferruginous; posterior metatarsi without long hind fringes.

Dimensions.—Length: queen, 15 mm. to 18 mm.; worker, 9½ mm. to 15 mm.; male, 11½ mm. to 15½ mm. Spread of wings; queen, 37 mm. to 39 mm.; worker, 23 mm. to 34 mm.; male, 28 mm. to 34 mm. Width of abdomen at second segment: queen, 9 mm. to 10 mm.; worker, 5½ mm. to 8½ mm.; male, 6½ mm. to 7 mm.

Redescribed from several queens (from Oregon and Idaho), from numerous workers (from Washington, Oregon and Montana) and from several males (from Idaho, Montana and New Mexico—one of them a cotype of *perixanthus* Ckll.).

I have here designated both the queens and workers, above described, as typical, on the basis of the coloration of the type queen, so that the color variations of both may be conveniently described together.

Variation.—This is one of our most variable species. I here describe such forms as seem marked distinctly enough to deserve description. Between these various forms, I have seen almost every conceivable gradation both in the males and in the females. I have also examined the genitalia of the males of the different color variants and of the two subspecies and I have found them all alike. There is one variation, belonging to this species, which seems to be distinctly marked enough (characters and habitat both considered) to be given the rank of subspecies. This variation does not seem to have been recognized by previous workers on the group. It is pretty generally distributed throughout the Pacific States and western Canada, though apparently a rare form everywhere, except in California, where, at least in portions of the state, it is very abundant. To this form I here give the name *nigroscutatus.* The two subspecies, with their respective color variants, are as follows:

Subspecies *occidentalis.*—The typical form above described; its color variants are:

Color Variant 1.—Queen and worker like the typical form, but with the fourth dorsal abdominal segment largely, and sometimes entirely, covered with white pile. Many specimens, from British Columbia, Washington, Montana, Utah, Oregon and Northern California (the *B. occidentalis* of Cresson).

Color Variant 2.—Queen and worker like Color Variant 1, but with more or less yellow pile on the third dorsal abdominal segment and

with the scutellum usually strongly yellow. Many specimens, from Washington, Montana, Alaska, Colorado and Utah.

Color Variant 3.—Queen and worker like Color Variant 2, but with the fourth dorsal abdominal segment entirely black; scutellum black. One worker from New Mexico and one queen from Colorado.

Color Variant 4.—(*B. proximus* Cress.). Queen and worker like Color Variant 3, but with the apical margin of the fourth dorsal abdominal segment usually fringed with white pile, the whole of the third segment and often an apical fringe on the second, of yellow pile and the scutellum more or less yellow. Many specimens from Colorado, British Columbia, Alaska and Utah.

Color Variant 5.—Queen and worker like Color Variant 4, but with the extreme sides, as well as the apical margin; of the second dorsal abdominal segment bearing yellow pile. Many specimens from Alaska, British Columbia, Colorado, New Mexico and Utah.

Color Variant 6.—(*Coloradensis* Titus). Like Color Variant 4, but with the fourth dorsal abdominal segment entirely covered with white pile. Rare in Colorado and western Nebraska.

Color Variant 7.—Queen like Color Variant 6, but with the apical margin of the second dorsal abdominal segment bearing yellow pile and the sides of the segment also with a large amount of pile of the same color; the scutellum entirely covered with yellow pile and the black interalar band with considerable yellow hair admixed. Three queens from Montana, Colorado and Utah.

Color Variant 8.—Worker like that of the typical form, but with the abdomen entirely black. Two specimens from Oregon and California.

Color Variant 9.—Worker like that of Color Variant 4, but with the second dorsal abdominal segment, except the very basal middle, entirely covered with yellow pile; mesopleura covered with yellow to the bases of the legs. A single specimen from Colorado.

Male Color Variant 1.—Like the typical male described above, but with the apical portion of the fourth dorsal abdominal segment bearing white pile; some touches of yellow hair often present about the bases of the legs. Several specimens from Alberta, British Columbia, Washington and Montana.

Male Color Variant 2.—Like Male Color Variant 1, but with the fourth dorsal abdominal segment entirely covered with white pile and with touches of yellow pile on the sides of the second dorsal segment. One specimen from Washington.

Male Color Variant 3.—Like Male Color Variant 1, but with touches of yellow pile on the sides of the second dorsal abdominal segment. One specimen from Washington.

Male Color Variant 4.—Like the typical form, but with touches of yellow pile on the sides of the second dorsal abdominal segment. Two specimens, from Washington and Montana.

Male Color Variant 5.—Like the typical form, but with more or less yellow pile on the third dorsal abdominal segment. Three specimens from Colorado and New Mexico.

Male Color Variant 6.—Like Male Color Variant 5, but with the fourth dorsal abdominal segment entirely covered with white pile. One specimen, from New Mexico.

Male Color Variant 7.—(*howardii* Cress.). Like Male Color Variant 5, but with the third dorsal abdominal segment entirely covered with yellow pile and the apical margin of the second segment bearing pile of the same color. Three specimens, from Colorado, California and British Columbia.

Male Color Variant 8.—Like Male Color Variant 7, but with the sides of the second dorsal segment bearing yellow pile. Several specimens from Colorado and Idaho.

Male Color Variant 9.—Like Male Color Variant 8, but with both the second and third dorsal abdominal segments entirely covered with yellow pile. Several specimens, from California, Colorado and Idaho.

Subspecies *nigroscutatus* subsp. nov.—In most respects like subspecies *occidentalis*:

Queen.—Dorsum of abdomen with segment one black; segment two with apical margin and sides yellow, the rest black; segment three entirely covered with yellow pile; segment four entirely black; segment five entirely covered with ferruginous-whitish pile; segment six either entirely black or with more or less ferrugino-whitish pile on the sides. Scutellum at most with no very great amount of yellow pile and usually entirely black or nearly so.

Worker.—Like the queen in most respects; the yellow often of a whitish shade; the wings usually lighter than those of the queen; the sixth dorsal abdominal segment always with ferrugino-whitish pile on the sides; the scutellum always entirely, or almost entirely, dark; the face darker than that of the queen, at most with no very noticeable amount of light pile.

Male.—Much like Male Color Variant 8 of the subspecies *occidentalis*, but with the pile on the three apical dorsal segments more ferruginous.

Described from nine queens, eighteen workers and eleven males. Cotypes all from California and deposited in the collection of the United States National Museum, the collection of Leland Stanford Jr. University, the collection of the American Entomological Society and the collection of the Massachusetts Agricultural College.

Color Variant 1.—Queen like the typical subspecies queen, but with the second dorsal abdominal segment at most bearing yellow pile only

on its apical margin and sometimes entirely black; scutellum sometimes entirely yellow and even the black interalar band with an admixture of yellow hairs. Three specimens, from California and British Columbia.

Color Variant 2.—Queen and worker like the typical subspecies queen and worker, but with the second dorsal abdominal segment, except the very basal middle, entirely covered with light yellow pile. Two specimens, from California and Montana.

Male, Color Variant 1.—Like the typical subspecies male, but with the second, as well as the third, dorsal abdominal segment nearly or entirely covered with yellow pile; the femora often largely clothed with light pile to their tips. Several specimens from California.

Male Color Variant 2.—Like Male Color Variant 1, but with the first abdominal segment bearing some yellow hair; face and occiput bearing mostly light yellow pile; ventro-lateral portions of the head with much yellow pile; thorax entirely covered with yellow, except for some dark pile in the middle between the bases of the wings and the dark metapleura and median segment; venter and femora largely clothed with light pile; the second dorsal abdominal segment entirely covered with yellow pile. Several specimens from California and Colorado.

The males and workers of this subspecies are by no means always distinguishable from those of the subspecies *occidentalis*, but as a rule they have more strongly ferruginous pile on the apical abdominal segments than do the males and workers of that subspecies.

The subspecies *nigroscutatus* is for *occidentalis* a variation in the direction of *B. terricola*, but the two species seem to me to be quite distinct, though it is not impossible that they should be considered as subspecies of the same species, as Handlirsch has considered them. They are certainly very closely allied.

Habitat.—This species ranges through at least the greater portion of Alaska(mouth of Dall River, Seldovia, Eagle and Nushagak River) and Yukon Territory, through the greater part of British Columbia (including Vancouver Island), through at least the western part of Alberta, through Washington, Oregon, Idaho and at least the western part of Montana, through the greater part of California, through the greater portion of Nevada, through Utah and all except the extreme eastern portion of Colorado, through the greater

part of Wyoming and a considerable part of New Mexico. It is probably also present in parts of the eastern portion of Arizona. Mr. Swenk has recorded the capture of a single female specimen in Sioux County, Nebraska. It should be noted that I have no Canadian records for it distinctly east of the eastern limits of the Rocky Mountains, though it seems not improbable that it may range considerably further east. What is its southern limit? My New Mexico records are: San Ignacio, Harvey's Ranch, Las Vegas Range, Beulah, Sante Fé Cañon and Costilla Range. The type locality of the *modestus* Smith worker is Oajaca, Mexico, but it seems very probable that this was a mistake. What are its extreme northern limits? It would be interesting to know if it is present on the Aleutian Islands and in Asia. It is pretty strictly confined to the Boreal Region and the Transition Zone and seems to be a fairly common species throughout a good portion of its range.

There is a single male before me, which is apparently an abnormal color variation either of this species or of *B. terricola*, from the Black Hills of South Dakota. What is the eastern limit of this species in the northern United States?

The species *occidentalis* is most closely related to *B. terrestris moderatus* Cress. on one side and to *B. terricola* Kirby on the other. It will be noted that *B. terrestris moderatus* has the second dorsal abdominal segment entirely covered with yellow pile while the third segment is always entirely dark; also the face and scutellum in that species are always entirely dark. *B. occidentalis*, on the other hand, never has anything more than mere touches of yellow pile on the second dorsal segment unless the third segment is entirely covered above with yellow pile; further, this species usually has more or less yellow pile on the face, especially on the queens and males and the scutellum is very often with a considerable amount of yellow pile. I have not seen any gradations tending to close the gap between these two species to any extent. For these reasons I cannot agree with Herr Handlirsch in considering them as varieties or subspecies of the same species.

Bombus (Bombus) terricola Kirby.

Bombus terricola W. Kirby, Fauna. Bor.-Amer., IV, 1837, p. 273, n. 379, ♀; T. 6, F. 4.
" " Cresson, Proc. Ent. Soc. Phila , II, 1863, p. 99, n. 23, ♀ ☿.
" " Packard, Proc. Essex Instit., IV, 1864, p. 112, ♀ ☿ ♂.
" " Bethune (Reprint, W. Kirby's Fauna Bor.-Amer.), Can. Ent., X, 1878, p. 117.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " Provancher, Natural. Canad., XIII, 1882, p. 267, n. 3, ♀ ☿ ♂.
" " Provancher, Faun. Entom. Canada. Hymen., 1883, p. 735, n. 3, ♀ ☿ ♂.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 234 (pars.).
" " Dalla Torre, Cat. Hym., X, 1896, p. 558.
" " Harvey and Knight, Psyche, VIII, 1897, p. 79.
" " Howard, Insect Book, 1904, Plate II, fig. 1, ☿ ; fig. 5, ♀.
? " " Kellogg, American Insects, 1905, p. 519.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.
" " Lowell, Ent. News, XVIII, May, 1907, pp. 196–197, ♀ ☿ ♂.
" " Titus, Biol. Surv. Mich., Ecology of Isle Royale, Lake Superior, 1908, p. 317.
" " Cockerell, Can. Ent., XLII, 1910, p. 25.
" *terrestris* var. *terricola* Friese and Wagner, Zoöl. Jahrb., XXIX, 1909, p. 28.

Type.—Probably in the collection of the British Museum, but its identity may be lost as Col. Bingham was unable to locate it definitely for me.

Pile of medium length and rather fine. Head mostly dark. Thorax with dorsum yellow in front and mostly dark behind; pleura dark. Dorsum of abdomen with segments one and four black; two and three yellow; five black, except light apical fringe; six black with light hairs on the sides. Legs dark; wings brown.

Queen. Head.—Face sometimes with a weak admixture of yellow hairs above and below the bases of the antennæ, otherwise entirely black. Labrum with tubercle-like areas having their margins rather sharply elevated and summits deeply concaved and for the most part

smooth; shelf-like projection rather wide and prominent; translucent areas faint or absent. Malar space scarcely as long as its width at apex, about one-sixth as long as the eye. Clypeus rather finely punctate. Flagellum of antenna about one and four-fifths times as long as the scape; third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile, the yellow often reaching down onto the mesopleura considerably below the level of the bases of the wings; the remainder entirely black, except the scutellum often more or less yellowish and occasionally entirely yellow.

Abdomen.—Dorsum: segments one and four entirely black; segments two and three yellow; segment five mostly black, but the apical margin always, and occasionally the whole apical half, bearing whitish yellow pile; segment six mostly black, but with more or less whitish yellow pile on the sides. Venter mostly black, the apical fringe of the preapical segment always more or less strongly ferruginous.

Wings.—Rather dark; the fore pair lightest across the middle portion.

Legs.—Dark; the corbicular fringes often more or less ferruginous.

Worker.—Much like the queen; the wings as a rule somewhat lighter; the face and scutellum rarely with any yellow hair mixed with the black.

Male. Head.—Shaped much like those of the females. Face often with a patch of unmixed dull yellow pile reaching down from the bases of the antennæ and covering the clypeus, but more often with black and yellow pile mixed in this region and usually with a sprinkling of yellow hairs about and above the bases of the antennæ. Occiput sometimes with yellow pile and occasionally with black, but usually with yellow and black mixed. Cheeks usually entirely black, but sometimes with a little yellow pile. Malar space about one-fifth as long as the eye. Clypeus mostly covered up with pile. Flagellum of antenna about two and one-third times as long as the scape; third antennal segment and fifth subequal in length, the fourth shorter than either.

Thorax.—Coloration of pile much like that of the queen, but the yellow pile often extending two-thirds of the way down on the mesopleura toward the bases of the legs.

Abdomen.—Dorsum: coloration of pile much like that of the females; fifth segment sometimes entirely black and sometimes with the apical margin fringed with light ferruginous pile; sixth segment rarely entirely black, usually at least the apical half ferruginous and occasionally the entire segment ferruginous; apical segment usually with entirely light ferruginous pile. Venter usually mostly dark, but occasionally with mostly light pile, always with a sprinkling of light hairs.

Genitalia.—As already described for the group. Sagitta with a flar-

ing flange, with serrate margin, at the base of the head on the lower side, in place of the tooth-like projection present in *affinis* and *occidentalis*.

Wings.—Usually slightly lighter than those of the worker; distinctly lighter than those of the queen.

Legs.—Mostly dark; hind and middle coxæ, trochanters and femora often with considerable light pile; fore and middle tibiæ often with considerable ferruginous pile on their hind sides; hind tibiæ with outer faces only very slightly convex and entirely naked, smooth and shining; corbicular fringes usually more or less strongly ferruginous; posterior metatarsi with no long hind fringes.

Dimensions.—Length: queen, 15 mm. to 18 mm.; worker, 10 mm. to 14 mm.; male. 11 mm. to 15 mm. Spread of wings: queen, 37 mm. to 40 mm.; worker. 26 mm. to 33 mm.; male, 27 mm. to 33 mm. Width of abdomen at second segment: queen, 10 mm. to 10½ mm.; worker, 5 mm. to 8 mm.; male, 6½ mm. to 8 mm.

Redescribed from numerous specimens of each caste.

Habitat.—I have records of this species from all the New England states, except Rhode Island, and from New York (Oneida, Long Island and Keene Valley). I also have the following Canadian records: Newfoundland (several localities), Prince Edward Island (Hampton), Quebec (Montreal), Hudson Bay Country, Ontario (Ottawa, Lake of Bays, Kabenakagami River and Nepigon), Manitoba (Arveme and Winnipeg), the new province of Saskatchewan (Oxbow and Regina) and Alberta (St. Albert, Calgary and Edmonton). It is almost sure to be present in New Brunswick, Nova Scotia and Rhode Island. My most southern records are Branford, Connecticut, and Long Island, New York. The Rocky Mountains probably mark its western limits in Canada. The type specimen was taken in Latitude 65°. What are its most northern limits? It seems to be a fairly common species through at least a good portion of its range of habitat. It is present in the northern parts of Wisconsin and Minnesota (Lake Itasca) and probably also of Michigan and North Dakota. It is mainly a Boreal form, but it runs over somewhat into the Transition Zone.

This species has its closest ally in the subspecies *nigroscutatus* of the species *occidentalis*. It differs from that form in always having the second dorsal abdominal segment entirely covered with yellow pile.

Bombus (Bombus) affinis Cress.

‖ *Bombus vagans* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 91, n. 4, ♀ (not the ☿ and ♂).
" *affinis* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 103.
" *vagans* Packard, Proc. Essex Instit., IV, 1864, p. 115, ♀ (not the ☿ and ♂).
" *affinis* Packard, Proc. Essex Instit., IV, 1864, p. 118, ☿ ♂.
" " Provancher, Addit.-faun. Canada Hymen., 1888, p. 339, n. 6, ♀ ♂.
" " Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 229, ☿.
" " Cresson, Trans. Amer. Ent. Soc. Phila., VII, 1879, p. 230 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307.
" " Dalla Torre, Cat. Hym., X, 1896, p. 504.
" " Titus, Can. Ent., XXXIV, 1902, p. 38.
" " Howard, Insect Book, 1904, Plate II, fig. 6, ♂.
" " Kellogg, American Insects, 1905, p. 519.

Types.—Originally described from a single worker, from Canada, which is in the collection of the American Entomological Society, and a single male from New York " (Coll. E. Norton)," which I have not located. There are several specimens of this species in the collection at Philadelphia, but the one labelled in Cresson's handwriting is the one he recognized as the type. The type specimens of the queen (described by Cresson as *B. vagans*) are in the collection of the American Entomological Society.

Pile comparatively short and dense; head black; thorax for most part covered with yellow pile; workers and males usually with a distinct black band between bases of wings; abdomen, except first two segments above, black; malar space short.

Queen. Head.—Rather broadly rounded for *Bombus*. When viewed from in front, as a rule, bearing only black pile, sometimes with a very slight admixture of yellow hairs with the black on the occiput. Labrum with an elevated tubercle-like area, broadly excavated at the summit and with rather sharply elevated border, on each side, with a shelf-like projection connecting the middle point of the inner sides of the two areas, this being broadly rounded in front and extending forward in a plane lying at an acute angle with the general plane of the labrum; the surface below this projection and also above it, between the two tubercle-like areas, strongly impressed; distal portion bearing a conspicuous amount of ferruginous pile; translucent spots rather small, invisible to naked eye, but easily visible with good hand lens. Malar

space distinctly broader than its average length; clypeus moderately and irregularly punctate, densely punctate at its lower corners. Third antennal segment longer than the fifth; fifth distinctly longer than fourth.

Thorax.—Dorsum of thorax, except a noticeable bare area on the disc, densely covered with yellow pile. Pile immediately surrounding bare area of disc usually with a slight admixture of black hairs, very rarely enough to make an indistinct black interalar band. Mesopleura well covered with yellow pile, without admixture of black hairs, to or very nearly to the bases of the legs. Upper plate of metapleuron usually bearing yellow pile on its front portion and black pile on its hind portion, sometimes with only dark pile and sometimes with very little; lower plate of metapleuron scantily clothed with dark hairs. Sides of median segment bearing dark brown or black pile; middle portion destitute of long pile, but bearing very short, fine, light colored pubescence.

Abdomen.—Dorsum of first segment bearing yellow pile for most part, its anterior corners with distinct, but rather inconspicuous, tufts of black hair, the anterior border of yellow pile with a few black hairs intermixed, middle portion of posterior margin of segment naked and shining; second segment entirely covered with yellow pile, the posterior margin of the yellow being broadly and gracefully notched; third, fourth and fifth segments entirely covered with black pile; sixth segment mostly black, but slightly rusty at tip. Venter rather scantily clothed with dark pile, without admixture of yellow; tip of apical segment somewhat rust colored. Hypopygium without median carina.

Wings.—Rather strongly stained with brown; the fore wings darker in region running back from the apical margin, to and including the fourth cubital and the apical cells, than on more basal portion; a small dark spot present near the sinus at the end of the frenal fold; radial cell with a narrow dark streak bordering the costal vein to its tip, where it unites with a similarly colored streak bordering the radial vein for a short distance.

Legs.—All the trochanters and femora bearing dark hair, with light hairs intermixed only very rarely; fore and middle tibiæ black, with black pile and with tips rust-colored or ferruginous on the outer side; hairs fringing bare outer surfaces of hind tibiæ (corbicular fringes) long and black; posterior metatarsi broad and bearing short spines and pubescence, the hairs at base on posterior side somewhat longer.

Worker.—Much like the queen in most respects, the following exceptions being noticeable: dorsum of thorax usually, though not always, with a distinct but somewhat indefinite band of black pile between the bases of the wings, there being always a more or less strong admixture of yellow hairs with the black; first dorsal abdominal segment with the tufts of black hairs at anterior corners smaller and less noticeable than in the queen, sometimes almost absent

(these black tufts are over the margin of the apparent dorsum of the abdomen, and may be best seen by looking at the insect from the side and somewhat in front, letting the line of vision pass under the wings at what appears to be the anterior face of the abodmen); second dorsal segment with the extreme sides and apical margins covered with yellow, the rest with brown ferruginous pile; translucent spots of labrum smaller than in queen, in some specimens absent; mandibles very variable, sometimes four and sometimes five toothed (figs. 37, 39, 40 and 41).

Male. Head.—Shaped much like that of queen. Bearing other than black pile only on the occiput. Occiput sometimes all black, but usually with a more or less strong admixture of yellow hairs; in some specimens with yellow pile predominating and not much black hair intermixed. Labrum broadly indented from side to side in front of the middle; surface rather coarsely punctate. Malar space about as long as its width at the apex; clypeus pretty well covered up with pile; antennæ rather short and stubby for male *Bombus*, the fifth segment slightly longer than third, fourth distinctly shorter than either.

Thorax.—Coloration of pile like that of the worker.

Abdomen.—Coloration of pile about like that of worker.

Genitalia.—In most respects like those of the other species of the *terrestris* group; the prominent tooth-like projection at about the base of the lower side of the head of the sagitta much broader than in *B. occidentalis* and serrate at its tip (fig. 121).

Wings.—In general like those of the queen and worker, but much lighter, the basal three-fourths of the fore wings being scarcely stained with brown.

Legs.—Trochanters usually with black pile only, sometimes with a very slight admixture of yellow hairs; femora with only black pile; tibiæ with black pile and rusty tips on the outer side. Posterior tibiæ with distinct and rather deep corbiculæ, the fringing hairs bordering an entirely bare area; outer surface flat or very slightly convex. Posterior metatarsi rather broad, concave on outer side, with curved posterior border and bearing rather short spines, pubescence and hair.

Dimensions.—Length: queens, 15 mm. to 21 mm.; workers, 9 mm. to 15 mm.; males, 11 mm. to 17 mm. Spread of fore wings: queens, 37 mm. to 43 mm.; workers and males, 23 mm. to 36 mm. Width of head: queen, 5 mm. to 6 mm.; worker, $3\frac{1}{3}$ mm. to 5 mm.; males, 4 mm. to 5 mm. Width of abdomen at second segment: queens, 8 mm. to $11\frac{1}{2}$ mm.; workers and males, 6 mm. to 9 mm.

Habitat.—This species is present in southeastern Canada, though apparently one of the rarer species there. It is not very common in northern New England, but apparently grows much more so southward. In southern New England

it is quite a common species, though less so than several others. It ranges southward through the Middle Atlantic States into South Carolina and Georgia, where it again appears to be rare, and westward certainly as far as Ramsey County, Minnesota, and probably somewhat farther. I know nothing of its southward range in the Central States, though, as I have seen specimens from Pittsburgh, Pennsylvania, it seems not unlikely that it may be found as far south as Kentucky. It apparently reaches its greatest abundance in the central portion of the Middle Atlantic States. It is mainly confined to the Transition and Upper Austral Zones, with no report of capture west of the Mississippi river. Redescribed from sixteen queens, fourteen workers and sixteen males. One of the workers was a specimen (homotype) previously compared by me with the type.

Nests.—I have seen but one nest of this species. I found it in early July in southern Vermont, in an open mowing on the surface of the ground. It was made up, in the usual way for surface nests, of dried grass and stubble woven together and, as the queen had apparently but recently started it, it contained only a few cells with partially developed larvæ in them. The nest was left as it was found so that the queen might develop her colony, but unfortunately it was accidentally destroyed a few days later.

Although this was a surface nest, the fact that the queens of this species are never seen in abundance, while the workers and males in late summer often appear in large numbers, together with the fact that their nests are so seldom found, leads me to the opinion that they are usually subterranean.

This species is very constant in its character, a remarkable fact when the extreme variability of a large proportion of the species of the *Terrestris* group is considered.

The indications that the queen, which I have here associated with the *affinis* worker and male of Cresson, properly belongs with them are so strong that it can hardly be doubted. Mr. J. C. Bridwell, who has done considerable work on the Bombidæ, first suggested the relationship to me. While I disagreed with him at first, I have been forced to the conclu-

sion that he was correct. The evidences of their relationship are as follows:

1. They have exactly the same range of habitat.
2. No other queen *Bombus* in the eastern part of the United States is without definitely and satisfactorily determined workers.
3. No other *Bombus* workers and males in the eastern United States are without a satisfactorily determined queen.
4. The queens, workers and males, by their structures, are all easily placed in the *Terrestris* group, of which there is no other eastern representative, except *B. terricola*.

THE BOREALIS GROUP.

"The group of *B. fervidus*" Radoszkowski, Bull. Soc. Natural. Moscow, xlix, P. 1, 1884. p. 77.

Type.—*Bombus borealis* W. Kirby. The first of the three species which Radoszkowski placed in this group was really *borealis*, but he misidentified it as *fervidus*.

Characters of the Group.

Females.—Pile rather short and fine; head elongate triangular in outline; mandibles as in *Pratorum* group; malar space long; clypeus impunctate, smooth and shining; abdomen tapering more gradually and evenly to the apex than with most *Bombus* species.

Males.—Head elongate, triangular, with long malar space; antennæ very long and slender; posterior tibiæ with outer surfaces distinctly concaved and bearing, for the most part, only short hair; traces of corbiculæ not very distinct; posterior metatarsi bearing only short spines and pubescence, with no long fringes, their outer faces distinctly concaved and finely and evenly pubescent.

Genitalia.—Outer spatha (fig. 138) from one-third to one-half as long, along its middle line from anterior to posterior border, as it is wide, from attachment to attachment; its anterior margin broadly, deeply and evenly incurved; posterior margin broadly and rather evenly outcurved, with a slight indentation at the middle. Inner spatha with posterior part strongly quadrangular, the apical half of this portion covered, on lower surface, with a dense coat of hair, this hair usually extending much farther forward along the sides than in the

middle; chitinous thickening on its anterior margin very heavy, especially so on the median projection: middle portion of this spatha usually with two parallel chitinous thickenings running almost anteriorly and posteriorly and usually with a line of hairs running up the middle line between them for a short distance; as a rule, without fenestræ. Claspers (figs. 61 and 68) long and rather thick and powerful in appearance; branches very broad at base, but narrowing rapidly to a sharply rounded, almost pointed, apex (as seen from above); volsellæ broad and heavy, narrowest toward apex, with broadly rounded and recurved apical projections, with very coarsely and irregularly serrate margins; squamæ large and prominent, with outer lobe vestigial, usually extending inward considerably past the inner margin of the volsellæ, irregularly quadrate, with inner posterior part pointed or nearly so; sagittæ with extremely irregular heads, consisting of a basal part with a prominent tridentate projection, this being connected, by means of a narrow elevated ridge, running along the shaft, with the very irregularly quadrangular apical portion, which has a very prominent anteriorly directed tooth on its outer end; shafts of sagittæ wide and flaring; uncus usually with a prominent recurved portion.

Bombus (Bombus) borealis Kirby.

Bombus borealis W. Kirby, Fauna Bor.-Amer., IV, 1837, p. 272, n. 378.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 93, n. 9.
" " Cresson, Proc. Ent. Soc. Phila., III, 1864, p. 41, n. 6, ♀ ☿ ♂.
" *fervidus* Putnam, Proc. Essex Instit., IV, 1864, p. 99 (pars.).
" " Packard, Proc. Essex Instit., IV, 1864, p. 110 (pars.).
" *borealis* Bethune (Reprint, Kirby's Faun. Bor.-Amer.), Can. Ent., X, 1878, p. 117.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *fervidus* Radoszkowski, Bull. Soc. Natural. Moscow, LIX, 1884, p. 77; T. 2, F. 25.
" *borealis* Cresson, Syn. Hym. No. Amer., 1887, p. 307, 1887 (Catal.).
" *fervidus* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 237 (pars.); T. 10, F. 5.

Bombus borealis Provancher, Addit. Faun. Canada. Hymen., 1888, p. 340, ♀ ♂.
" " Howard, Insect Life, I, 1889, p. 295.
" " Coville, Proc. Ent. Soc. Wash., I, P. 4, 1890, pp. 198 and 201.
" *fervidus* Dalla Torre, Cat. Hym., X, 1896, p. 519 (pars.).
" *borealis* Robertson, Trans. Ac. Sci., St. Louis, VII, 1897, p. 356.
" " Jarvis, Thirty-sixth Ann. Rep't Ent. Soc. Ont., 1905, p. 128.
" " Lowell, Ent. News, XVIII, May, 1907, p. 198.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 16; 1908, p. 111.

Types.—Queen probably in the collection of the British Museum, but identity apparently lost as Col. Bingham was unable to locate it definitely for me. Worker and male in the collection of the American Entomological Society.

Females with face and occiput covered with light pile; thoracic dorsum yellow, except for a broad black interalar band; pleura black; first four dorsal abdominal segments yellow, the rest black; venter black; legs black; wings rather dark; malar space rather long. Males like females, for most part, but the legs and venter with some light pile.

Queen. Head.—Rather elongate; face above and below the bases of the antennæ well covered with a large patch of whitish pile, with at most only a slight admixture of black hairs; occiput with pure whitish yellow pile, with little or no admixture of dark hair; sides of head dark, except for sometimes a little light pile near the top. Labrum with tubercle-like areas well separated, rounded above and flattened on the summits; shelf-like projection rather small, not very prominent; translucent areas very dim or absent. Malar space longer than its width at apex, nearly one-third as long as the eye. Flagellum of antennæ somewhat less than twice as long as scape; third antennal segment longer than fifth, the fifth longer than the fourth.

Thorax.—Center of disc bare, smooth and shining. Anterior part of dorsum and scutellum covered with yellow pile; a broad black band between the bases of the wings; mesopleura black from somewhat below the level of the bases of the wings to the bases of the legs; metapleura and sides of median segment dark.

Abdomen.—Dorsum: first four segments usually entirely covered with yellow pile, but the sides of the fourth sometimes with some black pile; segment five often entirely black, but usually with a slight admixture of light hairs on the apical margin; apical segment black. Venter mostly black, but sometimes with a slight sprinkling of light hairs. Hypopygium with a distinct carina on its apical third.

Wings.—Strongly stained with brown, the fore pair lightest in the middle portion.

Legs.—Coxæ black; trochanters mostly dark, but often with considerable light pile on their lower sides; femora and tibiæ dark.

Worker.—Much like the queen, but the wings usually somewhat lighter.

Male. Head.—Shaped much like that of queen. Face, above the bases of the antennæ, sometimes entirely black, but usually with a patch of whitish and black pile mixed extending both above and below the bases of the antennæ; occiput with a triangle of yellow pile and pile of the same color running out from it on each side along the occipital ridge; ventro-lateral sides of head mostly dark, but often with considerable light pile, this connecting with the occipital triangle. Malar space longer than its width at the apex, about one-third as long as the eye. Clypeus with middle part smooth and shining and at least the anterior portion not very well covered with pile. Flagellum of antennæ from three and one-half to four times as long as the scape; fifth antennal segment somewhat longer than the third, the fourth distinctly shorter than either.

Thorax.—Coloration of pile much as in females, but the lower parts of the mesopleura usually with more or less scattering yellow pile and occasionally covered with it to the bases of the legs; upper ends of metapleura, close under the bases of the wings, often with a noticeable touch of yellow.

Abdomen.—Dorsum: first four segments entirely covered with yellow pile; segment five entirely black, partly black and partly yellow in varying proportions, or entirely yellow; segment six often entirely black, but usually with the apical margin more or less heavily fringed with yellow; segment seven mostly black, but usually with a few light hairs on the sides. Venter occasionally almost entirely black, but usually with the apical margins of all, except the basal and apical, segments well fringed with light hair.

Genitalia.—Outer and inner spathas like those of *B. appositus* (fig. 138). Claspers and sagittæ as already described for the group (figs. 61 and 68); not separable by any noticeable structure from those of *B. appositus*.

Wings.—Considerably lighter than those of queen.

Legs.—Coxæ mostly black, but often with a few light hairs about their tips; trochanters usually with considerable light pile on their lower sides; femora occasionally entirely dark, but usually with considerable light pile; tibiæ dark.

Dimensions.—Length: queen, 15 mm. to 19 mm.; worker, 10 mm. to 15 mm.; male, 12 mm. to 15 mm. Spread of wings: queen, 32 mm. to 39 mm.; worker, 26 mm. to 32 mm.; male, 26 mm. to 31 mm. Width of abdomen at second segment: queen, 8 mm. to 9½ mm.; worker, 6½ mm. to 8 mm.; male, 6 mm. to 7½ mm.

Redescribed from numerous specimens of all sexes.

Habitat.—I have records of this species from Newfoundland, New Brunswick, Quebec, Ontario (Nepigon, Ottawa and Lake of Bays), Manitoba and Alberta (Beaver Lake) in Canada and from Maine, New Hampshire, Massachusetts, New York (northern), Michigan, northern Wisconsin and Minnesota (St. Paul and Lake Itasca) in the United States. It is probably present in the old territory of Assiniboia and in Vermont and northern North Dakota. In western Canada its range seems to end on the eastern side of the Rocky Mountains where it is completely replaced by its close ally, *B. appositus*. What are its northern limits? The type specimen came from Latitude 65 degrees. My most southern record for it is Amherst, Massachusetts, where it is extremely rare. I have no records from Pennsylvania, though I have seen a large amount of material from that state. It is mainly a Boreal form, but it runs over somewhat into the Transition Zone. In no part of its habitat does it appear to be a very common species.

This species has been confused with *B. fervidus* by many, on account of its somewhat similar coloration, but it is not even closely allied to that species. The females can be instantly separated from those of *fervidus* by means of the light pile on their faces and the males can be at once distinguished by their dark pleura. Specimens of this species also generally have the yellow pile more tawny than does *fervidus*. The females can be separated from those of its close ally, *appositus*, by the difference in coloration of the fifth dorsal abdominal segment, and the males from those of *appositus* by the much whiter pile on the front of the thorax in the latter species.

Bombus (Bombus) appositus Cress.

? *Bombus borealis* Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210.

" *appositus* Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 183, ♀ ☿ ♂.

" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).

Bombus appositus Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" " Ant. Handlirsch, Ann. Naturh. Hofmus. Wien, III, 1888, p. 234.
" " Dalla Torre, Cat. Hym., X, 1896, p. 511 (Catal.).
" " Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
" " Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 389.
" " Cockerell, Psyche, IX, 1901, pp. 272 and 282.
" " Titus, Can. Ent., XXXIV, 1902, pp. 38 and 40, ♀ ☿ ♂.
" *borealis* Titus, Can. Ent., XXXIV, 1902, p. 40.
" *appositus* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" " Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" " Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 240.
" " Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 242.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Dec. 17, 1906, Article XXV, p. 453, n. 114.
" " Univ. Color. Studies, IV, 1907, p. 258.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Types.—Type specimens of queen, worker and male are in the collection of the American Entomological Society. These specimens came from Colorado, New Mexico, Utah and Nevada.

Greater part of face, occiput and anterior part of dorsum of thorax covered with whitish pile; a black band between the bases of the wings; scutellum covered with tawny yellow pile; first five dorsal segments of abdomen covered with tawny yellow pile, apical segments black.

Queen. Head.—Face above and below the bases of the antennæ largely covered with whitish pile; occiput well covered with a triangular patch of whitish pile extending forward nearly to the ocelli; sides of head behind the eyes bearing rather scanty dark brown pile. Labrum much as in *B. affinis*, but with borders of the tubercle-like areas broadly rounded over and much less sharply elevated; translucent spots small or absent. Malar space fully one-third as long as the eye. Antenna with third segment nearly as long as the fourth and fifth taken together; fifth segment distinctly longer than fourth.

Thorax.—Anterior part of dorsum, back to the bases of the wings, covered with whitish pile; a broad black band between the bases of the wings, the black pile of this band having, however, in many specimens, a more or less strong admixture of whitish hairs, especially on the sides; surface of dorsum, in the middle of this band, bare of pile, impunctate and shining. Scutellum densely covered with tawny yellow pile. Upper portions of mesopleura covered with whitish pile, this being continuous with the pile of the same color on the anterior part of the thorax above; remainder of pleura bearing only dark pile.

Abdomen.—First five segments densely covered above with tawny yellow pile; apical segment black, except at very tip where it is slightly rusty. Venter dark, for the most part, but with the apical margins of all, except the first and last segments, fringed very noticeably with whitish hairs. Hypopygium with a distinct median carina on its apical third.

Wings.—Strongly stained with brown; fore wings evenly colored throughout for most part, darkest on apical halves of median and submedian cells and on anterior and apical portions of radial cell.

Legs.—Trochanters sometimes all black, but the middle and hind pair usually bearing more or less whitish hair intermixed with the black; fore coxæ also often with a little light pile. Fore femora usually all black; middle and hind femora as a rule bearing only black pile, but often with more or less whitish hair on the lower sides of their basal halves. Fore and middle tibiæ all black, except their tips on the outer sides, which are rusty; corbicular fringes of hind tibiæ black. Posterior metatarsi of medium width and bearing only short spines and very short hair or pubescence.

Worker.—Much like the queen. Many specimens with considerable whitish pile on sides of head behind the eyes. Labrum usually with translucent spots absent. Wings, as a rule, somewhat lighter than in queen.

Male. Head.—Pile of face like that of queen, but sometimes with a strong admixture of black hairs; a little patch of hair at the upper end of each eye black; sides of head, behind the eyes, sometimes with only dark pile, but usually with more or less whitish hair; occiput with pile as in queen. Labrum slightly bituberculate; malar space between one-third and one-half as long as the eye; clypeus usually pretty well covered up with pile, finely punctate for most part, front portion of disc smooth and shining; middle segments of flagellum of antennæ sometimes slightly arcuate; fifth segment slightly longer than the third, the fourth much shorter than either (fig. 25).

Thorax.—Coloration much like that of queen, but the mesopleura covered with whitish pile to bases of legs; metapleura and sides of median segment often covered with black, but usually with whitish pile.

Abdomen.—First five dorsal segments densely covered with tawny

yellow pile; fifth segment sometimes with a very few black hairs mixed in with the yellow; sixth segment often entirely covered with yellow pile, but as often with a more or less strong sprinkling of black hairs on the middle portion; apical segment mostly black, but usually with a more or less noticeable light tuft toward each side. Venter, except basal and apical segment, bearing whitish pile for the most part.

Genitalia.—Outer spatha with a variable (usually scattering) tuft of hairs on each side of the apical portion of the ventral surface (fig. 138). Basal part of head of sagittæ perforate close to the shaft.

Wings.—Colored about like those of the worker though, as a rule, somewhat lighter, distinctly lighter than those of the queen, only slightly stained with brown.

Legs.—Posterior coxæ bearing more or less whitish pile; all the trochanters and femora bearing a large amount of whitish pile and, as a rule, very little dark pile, except the fore and middle femora in front and the posterior femora behind and all the femora around very distal ends; tibiæ all dark.

Dimensions.—Length: queens, 14 mm. to 20 mm.; workers, 10 mm. to 14 mm.; males, 12 mm. to 17 mm. Spread of wings: queens, 35 mm. to 42 mm.; workers, 24 mm. to 35 mm.; males, 30 mm. to 33 mm. Width of abdomen at second segment: queens, 8 mm. to 9½ mm.; workers, 6 mm. to 8 mm.; males, 6½ mm. to 7½ mm.

Redescribed from twenty queens (two of them homotypes), fourteen workers (two of them homotypes) and nine males.

Habitat.—This handsome species appears to be confined to the mountain ranges and higher lands of the western United States and to the southwestern portion of Canada (probably the lower lands). The most southern records which I have are the Magdalena Mountains and Rio Ruidoso, New Mexico and Chino, southern California. My most northern record is Kelowna, British Columbia, where it does not appear to be rare. My most eastern record is Fort Collins, Colorado. I have records from the following states of the United States: Washington, Oregon, Montana (western part), Wyoming, Colorado, Utah, Nevada, California and New Mexico and from British Columbia only in Canada. It appears to be rather a rare species in New Mexico, Colorado, Utah and Nevada and to increase in abundance northwards until it reaches its maximum in western Montana, Idaho (probably), Washington and Oregon, where it appears to be

one of the common species. It is probably yet to be reported from Arizona, Lower California (northern part), Alberta, western Assiniboia, western Saskatchewan and western Athabasca. It probably is not present in any of the states east of those above mentioned or in Mexico proper. It appears to be confined mainly to the Canadian and Transition Zones, and it seems not improbable that it may range throughout a considerable portion of Alaska.

This species has by far its closest ally in the European *B. distinguendus* Morawitz, of which it is probably merely a variety, though I have not been thus far able to prove that such is the case. *B. distinguendus* has the pile on the anterior part of the dorsum of the thorax strongly yellowish instead of whitish as in this species. This species is comparatively very constant in all its important characters.

THE KIRBYELLUS GROUP.

Type.—Bombus kirbyellus Curtis. This group is newly established in this paper.

Characters of the Group.

Females.—Pile long and fine. Head very long triangular in outline; mandibles as in Pratorum group; malar space reaching its maximum in length; clypeus rather sparsely punctate, except at corners; hypopygium without median carina.

Males.—Head shaped much like that of female; antennæ moderately long and slender; posterior tibiæ with outer face very slightly convex and fringed in front and behind with very long hairs, forming a very distinct pollen basket; hind margins of posterior metatarsi fringed with long hairs.

Genitalia.—Claspers (figs. 63 and 77) long and rather slender in appearance; branches with broadly rounded apices, viewed from above; volsellæ very long and slender, gradually tapering from the base and with a broadly rounded and irregularly serrate-margined apical projection; squamæ oblong or irregularly triangular in outline, with the inner lobe vestigial or absent. Sagitta with very irregularly shaped head, this being bidentate at base on outer side and with apex foliaceous and recurved downward.

Bombus (Bombus) kirbyellus Curt.

? *Bombus balteatus* Dahlbom, Bombi Scandin., 1832, p. 36, n. 8, ♀.
? " *tricolor* Dahlbom, Bombi Scandin., 1832, p. 41, n. 17, ♂.
" *kirbyellus* Curtis, Descr. Insects Cl. Ross Second Voy., 1835, App., p. 42, n. 6, ♀ ☿ ♂; Tab. A, F 2 (♀).
" " Erichson, Arch. d. Naturgesch, II, P. 1, 1836, p. 287, n. 8.
? " *nivalis* Zetterstedt, Insect Lappon., I, 1838, p. 474, n. 7, ♀.
? " " Nylander, Notis. Saellsk. Faun. and Fl. Fenn. Förh., I, 1848, (Adnot.), p. 234, n. 17.
? " " Eversmann, Bull. Soc. Natural. Moscow, XXV, P. 3, 1852, p. 131, n. 7.
? " " Nylander, Notis. Saellsk. Faun. and Fl. Fenn. Förh., II, 1852 (Revis.), p. 262, n. 6.
" *kirbyellus* Smith, Catal. Hym. Brit. Mus., II, 1854, p. 397, n. 44, ♀.
" *balteatus* Schiödte, Etzel's Grönland, p. 611.
" " Aurivillius, Bih. Svensk. Vet.—Akad. Handl., XV, 1890, P. IV, p. 28.
" *kirbyellus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 101, n. 26, ♀ ☿ ♂.
" *balteatus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 108.
? " *nivalis* Thompson, Opusc. Entom., P. II, 1870, p. 258, n. 20, ♀ ♂.
?* " " Thompson, Hymen. Scandin., II, 1872, p. 35, n. 13, ♀ ☿ ♂.
? " *montanus* Radoszkowski, Bull. Soc. Natural. Moscow, LII, P. IV, 1874, p. 209 (p. p.).
? " " F. Moravitz, Fedtschenko: Turkestan Apid, I, 1875, p. 3, n. 4.
" *putnami* Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 185, ♀.
" *kirbyellus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *putnami* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
? " *nivalis* F. Moravitz, Bull. Ac. Sc. St. Petersbourg, XXVII, 1881, p. 229, n. 15, ♀ ♂.
? " " Schmiedeknecht, Apid. Europ., I, P. IV, 1882, pp. 269, 274, 275, 278, ♀ ☿, 284, 286, ♂ and p. 309, n. 7, ♀ ☿ ♂.
" *kirbyellus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *putnami* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *nidulans* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 232; T. 10, F. 6.

Bombus nidulans Ant. Handlirsch, Ann. naturh. Hofmus. Wien., IV, 1891, p. 453.
" *kirbyellus* Dalla Torre, Cat. Hym., X, 1896, p. 527.
" *putnami* Dalla Torre, Cat. Hym., X, 1896, p. 544.
" " Cockerell, Psyche, IX, 1901, p. 163.
" " Titus, Can. Ent., XXXIV, 1902, pp. 38 and 41.
" *atrifasciatus* Morrill, Can. Ent., XXXV, 1903, p. 224.
" *putnami* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *kirbyellus* Friese and Wagner, Zoölog. Jahrb. Suppl. 7, Festch Weismann, 1904, T. 30, F. 2, ♀.
" *putnami* Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" *kirbyellus* Cockerell, Can. Ent., XLI, January, 1909, p. 37.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17; ibid, 1908, p. 111.

Types.—Not improbably in the collection of the British Museum, but their identity apparently lost as Col. C. T. Bingham wrote me that he was unable to find them. The beautiful colored figures given with the original description are sufficient to identify the species with certainty.

Pile very long and fine. Head of females black. Thorax entirely covered with light pile, except for broad black interalar band; dorsum of abdomen yellow at base, black in the middle and whitish or ferruginous at apex. Wings light. Malar space very long.

Queen. Head.—Elongate in form. Face entirely black, except for occasionally a slight tuft of light pile between the bases of the antennæ; occiput usually entirely black, but sometimes with a very slight sprinkling of light hairs; sides of head behind eyes entirely dark. Tubercle-like areas of labrum with summits not very deeply concaved and only very sparsely punctate and upper (posterior) margins rounded, the space between them, above the shelf-like projection, rather small; translucent areas small and dim, almost absent. Malar space between one-third and one-half as long as the eye; clypeus sparsely punctate over disc, rather smooth and shining; flagellum of antennæ about twice as long as scape; third antennal segment distinctly longer than the fifth, the fifth longer than the fourth.

Thorax.—Dorsum entirely covered with very light yellow, in some specimens whitish, pile, except for broad black interalar band; the yellow on the anterior part not quite reaching back to the tegulæ in some specimens; anterior border of black band bending forward, and posterior backward in the middle, its length along the middle line, from front to hind margin, distinctly more than half its width from wing base to wing base; scutellum bearing only light pile. Mesopuelra entirely covered with light (whitish in most specimens) pile,

both back under the bases of the wings and to the bases of the legs. Metapleura and sides of median segment occasionally entirely dark, but usually with more or less light hair and often with light pile only. Colors of thorax as a whole sharply defined.

Abdomen.—Dorsum: first two segments always entirely covered with pure whitish-yellow pile; third segment mostly black, but always with a touch of light pile on the extreme side margins and often with a more or less strong fringe of the same color extending inward more or less toward the middle line along the apical margin; fourth segment very variable, often entirely covered with ferruginous or whitish yellow pile (of varying shade) and as often entirely black; fifth segment usually entirely covered with ferruginous or whitish yellow pile (of greatly varying shade), but sometimes with such a strong admixture of black hairs as to make this color greatly predominant; sixth segment always entirely black, except for rusty tip. Venter somewhat variable, but usually clothed (except first and last segments) for most part with light pile.

Wings.—Subhyaline; the fore pair darkest on median and submedian cells and on anterior part of the radial cell and about and beyond its apex.

Legs.—Coxæ sometimes entirely black, but usually with a more or less noticeable amount of light hair; trochanters seldom without a considerable amount of light pile on the lower side; fore and middle femora often entirely dark, but usually with a slight touch of light hair at their bases; hind femora usually with a conspicuous amount of light hair at least on basal portion, rarely entirely dark; fore and middle tibiæ, except rusty outer sides of apices, entirely dark; corbicular fringes usually more or less strongly ferruginous, but often entirely black.

Worker.—Like the queen, but with pile on metapleura and sides of median segment never entirely dark, usually entirely light; posterior and middle coxæ, trochanters and bases of femora never without some light hair; pile on dorsal abdominal segments four and five usually much more strongly ferruginous than in case of queen and also the venter with this ferruginous pile sometimes extending slightly onto the side margins of the corresponding segments.

Male. Head.—Shaped as in queen. Face with a large patch of yellow pile between and below the bases of the antennæ, this patch widely separated from the inner margins of the eyes on each side and sometimes with black hairs admixed; occiput bearing a median triangular patch of sometimes pure yellow pile, but usually with a very slight admixture of black hairs; ventro-lateral portions of head usually with considerable yellow pile. Malar space about one-half as long as eye; clypeus mostly covered up with pile; flagellum of antennæ about three times as long as the scape; fifth antennal segment

nearly as long as third and fourth taken together, third segment longer than fourth.

Thorax.—Colors arranged as in workers, but with interalar band much less sharply defined, there being a more or less strong admixture of yellow hairs with the black; metapleura and sides of median segment never with black hair.

Abdomen.—Coloration about like that of worker; third dorsal segment sometimes entirely black; fourth segment usually almost entirely black, except for some yellow hair on extreme side margins, sometimes entirely black; apical dorsal segment often entirely black, but as often entirely covered with ferruginous (of greatly varying shade) or whitish yellow pile, as with segments five and six; fifth segment often partly or entirely black. Venter, except the sides of the first segment and the apical segment, rather heavily clothed with long, light yellow pile; apical segment usually more or less tinged with ferruginous, especially on the apical margin, sometimes black.

Genitalia.— Outer spatha (fig. 123) with anterior lateral projections very long, slender and rounded at the end; main part a little less than one-third as long, from anterior to posterior border along the middle line, as wide, from side margin to side margin; anterior margin widely and rather evenly incurved; posterior margin broadly rounded on the sides, but rather widely and deeply incurved in the middle; ventral surface on each side of apical portion bearing a scattered patch of long hairs. Inner spatha (fig. 115) tridentate at apex. Claspers as described for group. Inner lobe of squamæ vestigial. Shaft of sagitta with a prominent projection a little in front of the middle of the lower side. See figs. 63 and 77.

Wings.—Usually a trifle lighter than those of queen and worker.

Legs.—Coxæ, trochanters and femora always with a large amount of yellow pile; fore and middle tibiæ often dark for the most part, but usually with a considerable amount of light or ferruginous pile on their outer and posterior sides and often within also; hind tibiæ with their outer faces bare and with fringes always more or less strongly ferruginous; posterior metatarsi with light or ferruginous hind fringes.

Dimensions.—Length: queen, 15 mm. to 19 mm.; worker, 11 mm. to 15 mm.; male, 12 mm. to 16 mm. Spread of wings: queen, 32 mm. to 41 mm.; worker, 26 mm. to 32 mm.; male, 30 mm. to 33 mm. Width of abdomen at second segment: queen, $8\frac{1}{2}$ mm. to $10\frac{1}{2}$ mm.; worker, $5\frac{1}{2}$ mm. to $8\frac{1}{2}$ mm.; male, 6 mm. to 7 mm.

Redescribed from seven queens (one of them the type of *atrifasciatus* Morrill and another a homotype of *putnami* Cresson), seventeen workers and ten males.

Variations.—As has been already shown in the above description, this species is a rather variable one, especially in the coloration of the abdomen. The queens usually have

the yellow pile very light, in some cases almost white, and many times the pile on the abdomen which is normally ferruginous is also very nearly white. The workers and males usually have the yellow and ferruginous much deeper and more pronounced than in the queens.

Habitat.—A strictly Boreal form. The writer has records from New Mexico (Truchas Peak), Colorado, Montana, Oregon (Mt. Hood), Labrador, Boothia Felix, Hudson's Straits, Hudson Bay Territory, Alberta, British Columbia, and Southern Alaska (Bartlett Bay at sea-level), and there is a queen before me from Sopka, Siberia. Aurivillius has reported it from Greenland (Polaris Bay, Port Foulke, Godhaven, Auleitsivik and Inigtut). In the western United States and southwestern Canada, it is confined to the highest ranges of the Rocky Mountains. In no part of its habitat in North America does it appear to be a common species. It may be present in northern Europe and, if so, *B. balteatus* Dahlbom may be the same species. Most of the descriptions, reference to which is made, in Dalla Torre's catalogue, under the names *balteatus* and *nivalis*, cannot be made to apply satisfactorily to this insect, as they describe the thoracic pleura as covered largely with dark pile. Aurivillius gives a very accurate description of true *kirbyellus* and its variations from Greenland specimens and states that the Greenland specimens differ from European ones.

This species is evidently most closely allied to *B. kincaidii* Cockerell and its next nearest relatives appear to be *B. polaris* Kirby and *B. arcticus* Kirby.

In a paper published in Ann. du Mus. Zool. de l'Acad. Imp. des Sci. de St. Pétersbourg, 1904, Tome IX, No. 4, H. Friese describes a new variety and a new subspecies of this species as follows:

"*B. kirbyellus* Curt. var. *lysholmi* n. var.—Entirely black, only segments four to six white haired. Subsp. *pyropygus* Friese—segments four to six red haired."

I am not sure whether these forms are valid forms of *kirbyellus* or not. If *lysholmi* is valid, it was, in all probability, described from a melanic specimen.

Bombus (Bombus) kincaidii Cockerell.

Bombus kincaidii Cockerell, Ann. and Magaz. Nat. Hist., Ser. 7, II, 1898, p. 324, ♀ ♂.

? " *gelidus* Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 127.

Psithyrus kodiakensis Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 130, ♂.

Bombus kincaidii Viereck, Ent. News, XIV, February, 1903, p. 54, ♀ ♂.

? " *gelidus* Ashmead, Hym. of Alaska, 1904, p. 133.

Psithyrus kodiakensis Ashmead, Hym. of Alaska, 1904, p. 136, ♂.

Types.—A queen and male are in the collection of the American Entomological Society and a worker is in the collection of the United States National Museum. The following description is from those specimens:

Pile long and rather fine. Females with head black; dorsum of thorax pale yellow, except for a broad black interalar band; pleura heavily shaded with dark hairs; dorsum of abdomen with the two basal segments densely yellow, third segment mostly yellow but less densely so than the first two; the remaining segments black; venter black; legs dark; wings light. Male with a tuft of yellow on the face; occiput with a sprinkling of yellow hairs; cheeks mostly dark; dorsum of thorax colored as in the females, but with a less definite black interalar band; pleura rather strongly shaded; dorsum of abdomen with the first two segments yellow, the remainder more or less shaded with black hairs and with some ferruginous pile on the two apical segments. Malar space long.

Queen. Head.—Entirely dark. Malar space about one-half longer than wide at apex; about one-third the length of the eye. Clypeus strongly punctate. Third antennal segment a little longer than the fifth.

Thorax.—Anterior part of dorsum and scutellum very light yellow; a broad oval black band between the bases of the wings, with its posterior border nearly straight. Pleura heavily shaded, the yellow pile for the most part stopping short near the bases of the wings, but yet, the upper parts of the pleura with a considerable sprinkling of yellow hairs (when viewed with a lens).

Abdomen.—Dorsum: segments one and two entirely and densely covered with yellow pile; segment three also covered with yellow pile, but much less densely so, the black of the integument showing through rather plainly and some black hairs admixed; the remaining segments black. Venter black. Hypopygium without a median carina.

Wings.—The fore pair with outer portions hyaline, the basal portions being considerably stained with brown; the hind pair hyaline throughout, except the veins.

Legs.—Black; the tips of the corbicular fringes slightly ferruginous; a little ferruginous hair on the hind sides of the fore and middle tibiæ.

Worker.—Like the queen, but with a narrower black interalar band and the pleura, though shaded somewhat with black hairs, pretty strongly yellow to the bases of the legs.

Male. Head.—Face below the bases of the antennæ and the clypeus bearing a distinct, but somewhat indefinite, tuft of yellow pile; occiput mostly dark, but with a strong sprinkling of yellow hairs; cheeks mostly dark, but with a few yellow hairs. Malar space between one-third and one-half as long as the eye. Third, fourth and apical antennal segments subequal in length, considerably shorter than any of the rest except the pedicel.

Thorax.—Coloration of pile on the dorsum much like that of the queen, but the black interalar band not nearly as definite as in that caste, there being a strong admixture of yellow hairs with the black. The pleura dark, but with a strong admixture of yellow hairs.

Abdomen.—Dorsum: segments one and two yellow; the following segments shaded with black hairs, but with light yellow hairs admixed somewhat, especially on the side margins, and predominant on the third segment; the two apical segments with considerable ferruginous hair. Venter with yellow hairs admixed with the black considerably.

Wings.—Hyaline, except the veins.

Legs.—Trochanters and femora heavily covered with very dull yellow pile, mixed with black hairs; fore and middle tibiæ with some ferruginous hair; hind tibiæ with very long ferruginous fringes; all the metatarsi fringed considerably with ferruginous hairs, those on the hind margins of the posterior pair being long.

Dimensions.—Length: queen, about 21 mm.; male, about 16 mm.

Habitat.—Pribilof Islands.

This species is apparently closely allied to both *strenuus* and *kirbyellus*. The latter, however, has a longer malar space in all its castes than does this species, and *strenuus* has the first three dorsal abdominal segments evenly and equally covered with yellow pile and the apical segments of the queen with considerable ferruginous hair. *Polaris*, another close relative, may be separated from *kincaidii* by the ferruginous-yellow pile of its apical dorsal segments and by its usually less punctate clypeus. I think it not improbable, however, that extensive collecting may prove that *kincaidii* is only a color variant or subspecies of either *strenuus* or *polaris*.

Bombus (Bombus) strenuus Cress.

Bombus strenuus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 102, n. 28, ♀ ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Dalla Torre, Cat. Hym., X, 1896, p. 551.
? " *frigidus* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 126.
? " " Ashmead, Hym. of Alaska, 1904, p. 132.
" *strenuus* H. Friese, Ann. du. Mus. Zool. de l'Acad. Imp. des Sci. de St. Pétersbourg, 1904, Tome IX, no. 4.

Types.—One queen and the male are in the collection of the American Entomological Society. They are in rather poor condition, the pile on both being matted down quite badly all over.

Malar space long. Pile long and rather fine. Females with head black; front part of dorsum of thorax and scutellum yellow; upper two-thirds of mesopleura yellow; a broad interalar band and the lower parts of the pleura dark; anterior half of abdominal dorsum yellow, anterior part of posterior half black and apex more or less ferruginous; wings light; legs dark. Male, except the head and legs, colored much like the female.

Queen. Head.—Trapeziform. Pile dark brown. Labrum with tubercle-like areas broad and somewhat concaved at their summits, their margins somewhat strongly elevated; space between these areas and above the shelf-like projection moderately broad. Malar space distinctly longer than its width at apex, fully one-third as long as the eye. Clypeus coarsely, but somewhat sparsely, punctate. Third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Anterior part of dorsum covered with light yellowish pile; scutellum similarly colored for the most part, but often with some black pile on its anterior part; a very broad black band between the bases of the wings; mesopleura somewhat variable, but usually with their upper halves light yellow and lower halves black; metapleura and sides of median segment with dark brown pile.

Abdomen.—Dorsum: three basal segments entirely covered with pile of much the same shade of yellow as that on the anterior part of the dorsum of the thorax; segment four black, but often with a few ferruginous hairs on the apical margin; segments five and six more or less ferruginous, usually more or less mixed with black. Venter mostly dark brown. Hypopygium with no distinct median carina.

Wings.—Subhyaline, only slightly stained with brown; the fore pair darkest in the median and submedian and anterior portion of the radial cells.

Legs.—Mostly dark brown, but with tips of corbicular fringes usually somewhat yellowish ferruginous.

Worker.—Not seen.

Male. Head.—Face and occiput with yellow and black pile mixed. Malar space between one-third and one-half as long as the eye. Clypeus pretty well covered up with mostly yellow pile. Third, fourth and apical antennal segments subequal in length, shorter than any of the rest except the pedicel.

Thorax.—Colored much like that of the females.

Abdomen.—Dorsum: first three segments yellow; segment four black; segment five mostly black; segments six and seven entirely ferruginous. Venter with strong admixture of yellow hairs.

Wings.—Clear hyaline.

Legs.—Coxæ, trochanters and femora with considerable yellow pile; hind tibiæ and fore, middle and hind metatarsi fringed with long, light ferruginous hair.

Dimensions.—Length: queen, 19 mm. to 25 mm.; male, 16½ mm. Spread of wings: queen, 43 mm. to 47 mm.; male, 34½ mm. Width of abdomen at second segment: queen, 10 mm. to 11½ mm.

Redescribed from four queens and one male.

Habitat.—I have only the three following definite records of this species: Hudson Bay Country, Fort Yukon (Alaska) and Fort Cosmos (Alaska). It must range through the country intervening between these points, but nothing definite is known concerning its limits in any direction. It is certainly a strictly Boreal form and it seems to be rare throughout its range of habitat.

This species is very closely allied to *B. kincaidii* Ckll. and apparently to *B. kirbyellus* Curtis also. It may be readily separated from the latter by means of the yellow third dorsal abdominal segment and the dark lower portions of the pleura. The third segment is more strongly and completely yellow than in *kincaidii*, and the yellow extends down onto the mesopleura farther than in that species; furthermore, the apical abdominal segments of the female *kincaidii* are entirely black.

Bombus (Bombus) polaris Curt.

Bombus polaris Curtis, Descr. Insects Cl. Ross' Second Voyage, 1835, App., p. 63, n. 7, ♀ ♂.

" " Erichson, Arch. f. Naturg., II, P. I, 1836, p. 288, n. 9.

" " Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 397, n. 43, ♀.

Bombus polaris Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 101, n. 27, ♀ ♂.
" " MacLachlan, Journ. Linn. Soc. Zoöl., XIV, 1877, p. 106, ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, p. 231, 1879 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Dalla Torre, Cat. Hym., X, 1896, p. 540.
" *nidulans* H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersbourg, 1904, Tome IX, no. 4.
" *polaris* H. Friese, ibid.

Types.—Probably in the collection of the British Museum, but they may have lost their identity as Col. Bingham was unable to locate them definitely for me.

Pile long and fine. Females with head black. Dorsum of thorax yellow, with a broad black band between the bases of the wings. Dorsum of abdomen with segments one and two yellow; segment three usually largely covered with dark pile, but with considerable yellow pile running across the middle or apical portion of the segment, sometimes entirely yellow; segment four sometimes with some black pile on its basal portion, but usually covered entirely with ferruginous-yellow pile (of varying shade); segment five entirely covered with ferruginous-yellow pile; segment six, of the females, largely black, but with considerable ferruginous-yellow hair, in the male entirely yellow-ferruginous; segment seven of the male entirely ferruginous-yellow. Venter and legs (including the corbicular fringes) of the females dark. Malar space rather long.

Queen. Head.—Face, occiput and cheeks black, with at most only a very slight sprinkling of light hairs. Malar space distinctly longer than its width at apex; about one-third as long as the eye. Clypeus rather smooth and shining on the disc, at most only moderately punctate. Third antennal segment distinctly longer than the fifth, the fifth distinctly longer than the fourth.

Thorax.—Dorsum covered with light yellow pile, except for a very wide black interalar band (this band being more than one-half as wide —from front to rear—as it is long—from wing base to wing base); mesopleura usually covered for the most part with dark brown or black pile, but often with the yellow pile extending down more than half-way from the dorsum to the bases of the legs (in anything like typical specimens, however, never reaching the bases of the legs). Metapleura variable, sometimes almost entirely dark and sometimes with mostly pale yellow pile. Sides of the median segment usually with very little or no light pile.

Abdomen.—Dorsum: segments one and two clothed with light yellow pile; segment three usually covered very largely with black pile, but usually with a more or less strong touch of light yellow pile run-

ning, in a very indefinite band (of varying width), across its middle or apical portion (sometimes this segment is almost entirely black and sometimes it has so much yellow pile that only traces of the black are noticeable); segment four sometimes with some black pile at its base, but usually entirely covered with ferruginous-yellow pile; segment five entirely covered with ferruginous-yellow pile; segment six more or less ferruginous-yellow. Venter sparsely clothed with dark brown or black pile, with very little or no admixture of light hairs. Hypopygium without a median carina.

Wings.—Subhyaline, only very slightly stained with brown; the veins of the fore pair noticeably darker than their membranes, and their general color lightest in the region beyond the veins, often in this portion being clear hyaline.

Legs.—Coxæ, trochanters, femora and tibiæ bearing little or no pile of a color other than dark brown or black; the corbicular fringes sometimes slightly ferruginous tipped. The corbicular areas comparatively very flat.

Worker.—Much like the queen, but with the mesopleura often covered with light yellow pile nearly or quite to the bases of the legs.

Male Head.—Face with a patch of pale yellow and black hairs mixed, between and below the bases of the antennæ and reaching down over the clypeus, but not approaching the inner margin of the eye on either side; occiput with a triangular patch of pale yellow pile; cheeks mostly dark. Malar space distinctly longer than its width at apex; fully one-third as long as the eye. Clypeus usually mostly covered with pile. Third and fourth antennal segments sebequal in length, the fifth much longer than either.

Thorax.—Dorsum covered with yellow pile, except for a wide, but more or less indefinite, black interalar band, there being usually at least a slight admixture of pale hairs with the dark pile; pleura light or dark, according to the specimen.

Abdomen.—Dorsum with coloration of pile much like that of the queen, but the third segment sometimes entirely yellow and the apical segments always entirely covered with ferruginous-yellow pile (of greatly varying shade); some specimens with all the first five segments entirely covered with yellow, and the two apical ones with light ferruginous-yellow pile. Venter clothed with dark brown and pale yellow pile quite evenly mixed over all the segments, but in greatly varying proportions on different specimens.

Wings.—Mostly hyaline.

Legs.—Coxæ, trochanters and femora, all bearing a considerable amount of yellow pile; fore tibiæ mostly dark; middle tibiæ with considerable ferruginous pile on their hind sides; hind tibiæ with outer faces somewhat convex and mostly bare on their distal halves, their fringes long and strongly ferruginous or ferruginous-yellow; hind metatarsi with rather long ferruginous-yellow hind fringes.

Genitalia.—Outer spatha in general like that of *B. kirbyellus* (fig. 123), but with the hind margin almost straight instead of distinctly incurved. Inner spatha (fig. 165) with its front margin arcuate outward and its side margins deeply incurved; its apical portion tapering to a blunt point. Claspers (figs. 150 and 158) long and slender; their branches, as seen dorsally, with broad and somewhat irregularly rounded apices; the volsellæ very long and slender, with their margins mostly even and with their apical projections large, prominent, rounded and with somewhat serrate apical margins; squamæ with inner lobe entirely absent, the outer lobe being large and elongate, rounded at the apex and rather suddenly narrowed at the base and with both its inner and outer margins nearly straight. Sagittæ but little different from those of *kirbyellus*. Uncus very broad, though tapering to a recurved apex of medium width; with evenly outcurved side margins.

Dimensions.—Length: queen, 16 mm. to 18 mm.; worker, 11 mm. to 14 mm.; male, 14 mm. to 16 mm. Spread of wings: queen, about 39 mm.; worker, 27 mm. to 30 mm.; male, about 30 mm. Width of abdomen at second segment: queen, about 10 mm.; worker, 6 mm. to 7 mm.; male, about 7 mm.

Redescribed from many queens, seven workers and five males. All these specimens are in the collection of the Museum of Comparative Zöology at Cambridge, most of them having been collected by J. D. Sornborger and A. Stecker.

Habitat.—The writer has records of this Boreal species as follows: Labrador (Rama, Nain, Ft. Chimo and Ungava Bay) and Greenland (McCormick Bay). Dr. Ashmead reported the species from Alaska (Hym. of Alaska, p. 133), but I consider that record questionable as I have found no specimens of what I consider to be true *polaris*, from that region, in the collection of the United States National Museum. I do not, however, think it impossible, or even improbable, that the species may be present in Alaska.

This species appears to be closely related to *B. kirbyellus* and *B. arcticus*. From the former, its females may be separated by their shorter malar space and more flat and even surfaced corbicular areas and its males by their much shorter malar space. The females of *arcticus* also have a distinctly longer malar space than do the females of this species. The female of *strenuus*, which species is apparently the closest ally to *polaris* and resembles it quite strongly in coloration, may be definitely separated from the female of this species

by the different coloration of the third and fourth dorsal segments of its abdomen and by its more strongly punctate clypeus.

Specimens of this species are rather somber in appearance and without sharp contrasts in the coloration of their pile. A considerable portion of the yellow pile of most specimens has a strong tendency to be pale and lustreless. The ferruginous-yellow pile on the apical dorsal abdominal segments varies greatly in shade, being sometimes whitish and sometimes strongly ferruginous.

Bombus (Bombus) arcticus Kirby.

‖ *Apis alpina* O. Fabricius, Fauna Grönland, 1780, p. 199 (Non Linné).
? * *Bombus hyperboreus* Schonherr, Svensk. Vet.-Akad. Handl., XXX, 1899, p. 57, ♀, T. 3, F. 2.
" *arcticus* W. Kirby, Anim. Parry's First Voy., 1821, Append., p. 216, ♀ ♂.
? " *hyperboreus* Dahlbom, Bombi Scandin., 1832, p. 42, n. 19.
" *arcticus* Curtis, Desc. Insects Cl. Ross' Second Voy., 1834, App., p. 64, n. 8, ♀ ♂.
" " Erichson, Arch. f. Naturg., II, P. 1, 1836, p. 288, n. 10, ♀ ♂.
? " *hyperboreus* Zetterstedt, Insect. Lappon., I, 1838, p. 475, n. 11, ♀.
? " " Nylander, Notis. Saellsk. Faun. and Fl. Fenn. Forh., I, 1848 (Adnot.), p. 230, n. 8.
" *groenlandicus* (Westermann) Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 393, n. 23, ♀.
" *hyperboreus* Schiödte, Etzel's Gronland, p. 611.
" *arcticus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 95, n. 13, ♀ ♂.
" *groenlandicus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 97, n. 16, ♀.
" *hyperboreus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 108.
? " " Thomson, Opusc. Entom., P. 2, 1870, p. 256, n. 14, ♀ ♂.
? * " " Thomson, Hymen. Scandin., II, 1872, p. 34, n. 12, ♀ ☿ ♂.
" *arcticus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.),
" *groenlandicus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).

? ? *Bombus hyperboreus* F. Moravitz, Bull. Ac. Sci. St. Petersbourg, XXVII, 1881, 231, n. 16, ♀ ♂.
? " " Schmiedeknecht, Apid. Europ., I, P. 4, 1882, p. 276, ♀ ☿, 290, ♂, and 307, n. 6, ♀ ☿ ♂.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308 (Catal.).
" " Fox, Proc. Ac. Nat. Sci. Phila., 1892, p. 135.
? " " Aurivillius, Bih. Svensk. Vet.—Akad. Handl., XV, 1890, P. 4, p. 27.
? " " Friese and Wagner, Zoölog. Jahrb. Suppl. 7, Fetsch. Weismann, 1904, T. 30, F. 1, ♀.
" " Cockerell, Can. Ent., XLI, Jan., 1909, p. 37.
? " " H. Friese, Ann. du Mus. Zool. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, n. 4.
? " " *arcticus* H. Friese, ibid.

Types.—Probably in the collection of the British Museum, but their identity may be lost as Col. Bingham was unable to locate them definitely for me.

Head black; anterior part of dorsum of thorax and scutellum covered with light yellow pile; pleura dark and a broad black interalar band present; dorsum of abdomen typically with the two basal segments yellow and the remainder black. Malar space long. Pile long and fine.

Queen. Head.—Elongate triangular in outline and bearing only black pile; labrum as in *B. affinis* ♀; malar space about one-half as long as the eye; clypeus moderately punctate over its entire surface; fifth antennal segment about equalling the third in length, fourth segment shorter.

Thorax.—Anterior part of dorsum and scutellum covered with pale yellow pile; pleura, except for a little just below the bases of the wings, bearing dark pile; a broad and distinct black band between the bases of the wings.

Abdomen.—First two dorsal segments covered with pale yellow pile, the remaining dorsal segments black; venter black. Hypopygium without median carina.

Wings.—Strongly stained with brown, a trifle lighter than those of the queen of *B. perplexus* Cress.

Legs.—Coxæ, trochanters, femora, fore and middle tibiæ and corbicular fringes black.

Worker.—Much like the queen in all respects except size.

Male. Head.—Face and sides behind the eyes black; occiput largely covered with pale yellow pile. Malar space fully one-half the length of the eye. Fifth antennal segment much longer than either the third or the fourth, these two segments being subequal; apical segment the shortest of all except the pedicel.

Thorax.—Black band between the bases of the wings rather indefinite; pleura, except a little just below and in front of the bases of the wings, black; scutellum well covered with pale yellow pile.

Abdomen.—Coloration like that of abdomen of queen.

Legs.—Coxæ, trochanters, femora, and tibiæ black. Hind tibiæ and metatarsi fringed behind with long hairs.

Dimensions.—Length: queen, 26 mm.; worker, 18 mm.; male, 21 mm. Spread of wings of queen, 43 mm.

Redescribed from two queens, one worker and one male.

Habitat.—Greenland and Arctic Canada. I have records of its capture at Godhaven and Disco in Greenland. The type specimens were taken in Boothia Felix (Arctic Canada). It seems not improbable that this is the same species which is present in the northern regions of Europe and Asia and is known as *B. hyperboreus* Schönherr. F. Morawitz, however, in describing what he took to be this European and Asiatic species described the queen as having the malar space about as long as its breadth at the apex.

I have seen a Schmitt box full of specimens of this species in the collection of the American Entomological Society. Unfortunately, when examining the types in that collection, I did not have the time to examine these specimens carefully and note their places of capture. It was at once evident to me, however, that this species is quite a variable one in its coloration, particularly on the abdomen, which often has a very strong admixture of pale yellow pile on its apical two-thirds.

THE PRATORUM GROUP.

"The group of *B. pratorum* L.," Radoszkowski, Bull. Soc. Natural. Moscou, XLIX, P. I, 1884, p. 59.

Type.—*Bombus pratorum* Linnæus.

Characters of the Group.

Females.—Pile medium to long, of variable texture; head somewhat variable, but in most species distinctly triangular in outline; malar space usually of fully average length; mandibles distinctly three-toothed and usually with a more of less distinct straightening or incurving of the lower apical margin, suggestive of a fourth.

Males.—Antennæ of not more than average length for *Bombus* male; posterior tibiæ fringed with long hairs on anterior and posterior borders, forming more or less strong corbiculæ; hind metatarsi with posterior fringe variable, never very short and in most species rather long.

Genitalia.—Claspers appearing rather slender and weak; the apex of each branch as seen from above broadly rounded, its inner side, in most cases, more or less pointed and passing the inner margin of the volsella (figs. 64, 65, 69, 72 and 74); volsella long and slender, usually of about the same width throughout, except at the base, where it is, in most cases, rather suddenly wider; squama triangular in outline, the inner lobe being vestigial or absent; sagitta with a long, rather slender shaft, having a prominent tooth-like projection on its lower side at about the middle, and a sickle-shaped head, the plane of the sickle being about at right angles with the shaft with its tip directed ventrally.

Bombus (Bombus) bimaculatus Cress.

Bombus bimaculatus Cresson, Proc. Entom. Soc. Phila., II, 1863, p. 92, n. 6, ♂.
" " Packard, Proc. Essex Instit., IV, 1864, p. 117, ♂.
" *ridingsii* Cresson, Proc. Acad. Nat. Sc. Phila., 1878, p. 182, ♀ ☿.
" *bimaculatus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *ridingsii* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *bimaculatus* Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" *ridingsii* Cresson, Syn. Hym. No. Amer., 1887, p. 308 (Catal.).
" *bimaculatus* Dalla Torre, Cat. Hymen., X, 1896, p. 512 (Catal.).
" *separatus* Dalla Torre, Cat. Hymen., X, 1896, p. 546 (pars.) (Catal.).
" " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, pp. 177 and 178, ♀ ♂.
" *bimaculatus* Howard, Insect Book, 1904, Plate II, fig. 4, ♂, fig. 8, ♀.
" *ridingsii* Swenk, Ent. News, XVIII, July, 1907, p. 296, n. 5.

Types.—Described from a single aberrant male from Connecticut which I have not located. There are, however, three males, labelled by Cresson and giving his idea of the species, in the collection of the American Entomological Society. The queen and worker types (described as *ridingsii* by Cresson) are also in this collection.

Pile of medium length and rather coarse. Head black for most part; occiput bearing a patch of yellow pile; thorax, except disc of dorsum, covered with yellow pile; abdomen with basal segment and basal middle of second segment of dorsum covered with yellow pile, the remainder usually black. Malar space rather long.

Queen. Head —Elongate triangular in form; occiput bearing a triangular patch of yellow pile, sometimes pure, sometimes with a very strong admixture of black hairs; remaining portions of head bearing black pile only. Labrum (fig. 114) much as in *B. affinis*, but with the tubercle-like areas rather broadly rounded over, without sharply elevated margins and not very much excavated at the summit, also with shelf-like projection connecting them rather narrow and weak; translucent areas very large, easily visible to the naked eye. Malar space distinctly longer than its width at the apex, slightly more than one-quarter as long as the eye; clypeus sparsely punctate, shining; third antennal segment distinctly longer than the fifth and the fifth distinctly longer than the fourth.

Thorax.—Dorsum covered for the most part with yellow pile, disc naked, impunctate and shining, the surrounding pile with a more or less strong admixture of black hairs sometimes slightly suggestive of a black interalar band. Pleura bearing yellow pile nearly to, in many specimens quite to, the bases of the legs; sides of median segment usually bearing yellow pile, but in some specimens with almost entirely black pile.

Abdomen.—Dorsum with basal segment bearing only yellow pile; second segment with a basal middle patch of yellow pile of varying size, sometimes a mere strip and sometimes reaching back nearly to the apical margin of the segment, the remainder of the segment covered with black pile; the remaining segments bearing only black pile. Venter rather sparsely clothed with dark hair. Hypopygium without median carina.

Wings.—Strongly but not deeply stained with brown; fore wings darkest at the median and submedian cells and at the anterior and apical portions of the radial cell and in the broad apical area beyond the region of the veins.

Legs.—Coxæ, trochanters and femora bearing black pile, rarely with a very slight sprinkling of yellow hairs; anterior and middle tibiæ and corbicular fringes black. Posterior metatarsi bearing only very short hair, spines and pubescence.

Worker.—In general much like the queen. Yellow pile of pleura usually reaching the bases of the legs; yellow patch on basal middle of second abdominal segment in many specimens reaching the apical margin of the segment; sides of median segment seldom, if ever, with anything but yellow pile.

Head. Male.—Triangular in outline, as viewed from in front. Face, above and below the bases of the antennæ, bearing yellow pile with a more or less strong admixture of black hairs, the black being predominant on many specimens; occiput with yellow patch usually having no admixture of black hairs; sides of head behind the eyes usually with a considerable amount of light pile, but in some specimens with black hair only; pile around upper ends of eyes always black. Labrum not tuberculate, broadly, but not deeply, and transversely concave in front of the middle. Malar space not more than one-fourth as long as the eye; clypeus pretty well covered up with pile; fifth antennal segment distinctly longer than either the third or the fourth, the third somewhat longer than the fourth.

Thorax.—Coloration of pile about as in worker, but yellow of pleura always reaching bases of legs; median segment never with black pile on the sides; disc of dorsum in majority of specimens with no admixture of black hairs.

Abdomen.—Dorsum much as in worker but with even a greater tendency on the part of the patch of yellow on the basal middle of the second segment to reach the apical margin of the segment; many specimens with the yellow not only reaching the apical margin of the second segment, but also extending outward on each side along that margin and finally even reaching the extreme side margins, leaving only two spots or patches of black pile on the segment and thus justifying the name *bimaculatus* for the species; remainder of dorsum as a rule bearing only black pile. Venter usually with some black hair, especially toward the base, but for the most part clothed with light pile.

Genitalia.—Outer spatha about one-third as long (along the middle line from anterior to posterior border) as it is wide (from anterior projection to anterior projection); anterior border broadly incurved or broadly v-shaped; posterior border rather irregular, distinctly and widely incurved at apical middle; ventral surface with a somewhat scattering tuft of rather short hairs on each side near the posterior margin, these two tufts being placed on somewhat elevated areas and with scattering hairs between them on a broadly forward curved area; general appearance somewhat like that of *B. vagans* Smith (fig. 131). Inner spatha broadly bifid at the apex and with apical portion of the ventral surface rather thickly covered with hair; general appearance about like that of *B. separatus* (fig. 127). Claspers about like those of *B. fernaldi* (figs. 74 and 110).

Wings.—A trifle lighter than those of the queen.

Legs.—Coxæ, trochanters and femora all bearing a considerable amount of yellow pile; anterior sides of anterior femora and posterior sides of middle and hind femora and apical portions of all the femora mostly with black pile; fore and middle tibiæ for most part black, but often with a few hairs of a distinctly ferruginous tinge on the outer side near the tip; a large part of the short hair on the fore and middle metatarsi with a distinctly ferruginous tinge. Posterior tibiæ with outer faces flat or slightly convex and without any very definitely bare areas; anterior borders with short fringes and posterior borders with rather long ones, thus forming distinct but weak corbiculæ. Posterior metatarsi bearing, for most part, only short spines and pubescence but with posterior borders bearing fringes of rather long hairs, these hairs and the posterior fringes of the posterior tibiæ usually more or less strongly ferruginous.

Dimensions.—Length: queens, 15 mm. to 21 mm.; workers, 8 mm. to 15 mm.; males, 9. mm. to 15 mm. Spread of fore wings: queens, 33 mm. to 42 mm.; workers, 23 mm. to 33 mm.; males, 24 mm. to 32 mm. Width of abdomen at second segment: queens, 9 mm. to 11 mm.; workers, 5 mm. to 9 mm.; males, 5 mm. to 8 mm.

Redescribed from numerous queens (two of them homotypes of the queen *ridingsii* Cress.), 17 workers (two of them homotypes of *ridingsii*) and nine males.

Habitat.—Very rare in southeastern Canada, ranging southward through the New England and Middle Atlantic States into Georgia and Alabama and westward as far as into eastern Nebraska. My most western records are Southbend, Nebraska and Louisiana. The species is probably yet to be reported from the eastern portions of Texas, Oklahoma, Kansas and the Dakotas. It is very doubtful if it is present in Florida, southern Louisiana, or the northern parts of Minnesota, Michigan or Maine. In no part of its habitat does it seem to be one of the more common species. It appears to reach its greatest abundance in Pennsylvania, Ohio, West Virginia and Maryland and is apparently confined mainly to the eastern portion of the Transition and Upper and Lower Austral Zones.

Nests.—I have found but a single nest of this species. It was located on the surface of the ground, among the bases of saplings, in a thicket of alders in Bernardston, Massachusetts. The nest was made up of dried grass in the usual way and contained six queens, ten workers and nine males,

besides a considerable number of cells with partially developed larvæ. The nest was taken July 15, 1904. The workers of this species are very waspish and, next to those of *B. vagans* F. Sm., are the most ready to use their stings of all those with which I have had any experience.

This species has its closest ally in *B. impatiens*.

The males of this species occasionally sport by having one or more of the apical segments of the abdomen partially or wholly covered with yellow pile as in the case of the type male, which had the fourth segment covered with black and yellow pile mixed. This sporting tendency of the males is paralleled in the queens as I have already shown under the topic " Freak Specimens."

Bombus (Bombus) impatiens Cress.

? *Apis griseo-collis* De Geer, Mem. Ins., III, 1773, p. 576, Pl. 28, figs. 13–14.
" " Olivier, Encycl. Meth. Ins., IV, 1789, p. 64.
" *virginicus* Olivier, Encycl. Meth. Ins., IV, 1789, p. 66.
Bombus virginicus Fabricius, Syst. Piez., 1804, p. 346.
Bremus " Jurine, Nouv. Meth. class. Hymen., 1807, p. 260, ♀.
? *Bombus impatiens* Harris, Catal. Insects Mass., 1835, p. 70 (nom. nud.).
" *virginicus* Harris, Catal. Insects Mass., 1835, p. 70 (Catal.).
" " St. Fargo, Hymenopteres, I, 1836, p. 470.
" " Kirby, Faun. Bor.-Amer., IV, 1837, p. 274.
" " Smith, Brit. Mus. Cat. Hym., II, 1854, p. 398.
" " Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 170.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 87, ♀ ☿ (not the ♂).
" *impatiens* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 90, n. 2, ♂.
" *virginicus* Cresson, Proc. Ent. Soc. Phila., 1863, p. 166, ♀ ☿ ♂.
" " Putnam, Proc. Essex Instit., IV, 1864, p. 101.
" " Packard, Proc. Essex Instit., IV, 1864, p. 113, ♀ ☿ ♂.
" " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210.
" " Bethune. (Reprint, W. Kirby's Faun. Bor.-Amer.), Can. Ent., X, 1878, p. 118.

Bombus virginicus Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" " Riley, Am. Ent., III, 880, p. 107, ♀.
" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " McCook, Tenants of an Old Farm, 1885, pp. 153 to 173, figs. 51, 53 and 55.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 228; T. 10, F. 9.
" " Provancher, Addit. Faun. Canada. Hymen., 1888, p. 338, n. 5, ♀ ☿ (not the ♂).
? *Psithyrus insularis* Provancher, Addit. Faun. Canada. Hymen., 1888, p. 342, ♂ (not the ♀).
Bombus virginicus Howard, Insect Life, III, 1891, p. 431
" " Smith, Economic Entomology, 1896, fig. 473 d, ♀.
" " Dalla Torre, Cat. Hym., X, 1896, p. 563.
" " Titus, Can. Ent., XXXIV, 1902, pp. 37 and 44.
" " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, pp. 177 and 178.
" *morrisonii* Howard, Insect Book, 1904, Plate 3, fig. 37.
" *virginicus* Smith, Economic Entomology, 1906, fig. 473 d. ♀.
" " Swenk, Ent. News, XVIII, July, 1907, p. 296, No. 4.
" sp. Hunter, Elements of Biology, 1907, p. 37, figs. a and c, ♀ ♂.
" *virginicus* McCook, Nature's Craftsmen, 1907, p. 159, fig.
" *impatiens* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 16.
" *virginicus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Type.—Cresson made his description of *impatiens* from a single male "in the collection of Mr. Norton" which "was compared with specimens so named in the Harris collection." I have been unable to find any specimen of *Bombus*, labelled "*impatiens*," in the collection of the American Entomological Society and I am therefore ignorant of the whereabouts of Cresson's type. Specimens of several distinct species in the Harris collection are labelled "*impatiens*." I have been obliged, therefore, to rely largely on Cresson's description for the determination of his species. Cresson, however, described this species later under the name *virginicus*, as the synonomy above shows, and after this later description he says, "To the list of synonyms of this species" (viz., *vir-*

ginicus) "add *Bombus impatiens* Harris, Cat. Ins. Mass. Second edition, Cresson, Proc. Ent. Soc. Phila., II, p. 90, ♂." The collection of the American Entomological Society contains a series of specimens determined as *B. virginicus* by Cresson.

Pile rather short and coarse. The dorsum of the thorax and the pleura to the bases of the legs covered with yellow pile. Dorsum of abdomen with the first segment yellow and the rest black. Malar space of females rather short and their corbicular fringes black

Queen. Head.—Broad and somewhat rounded. Face entirely black or with a sprinkling of yellow hairs about the bases of the antennæ; occiput with a triangular patch of yellow pile, but very often with a more or less strong admixture of black hairs; cheeks black. Labrum with tubercle-like areas well separated, their margins rather sharply elevated and summits deeply concaved; the region between these areas and above the shelf-like projection deeply excavated; shelf-like projection wide and prominent; translucent areas faintly visible to the naked eye. Malar space somewhat shorter than its width at the apex; about one-sixth as long as the eye. Clypeus rather finely and unevenly punctate over the disc. Flagellum of antenna about twice as long as the scape; the third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—A narrow linear space on the disc bare and smooth, the dorsum otherwise, and the mesopleura to the bases, of the legs, covered with yellow pile, there being an admixture of black hairs on the dorsum between the bases of the wings, giving this region a somewhat shaded appearance; metapleura with yellow pile, except on their lower parts; sides of median segment bearing yellow pile, but very often with black hair more or less strongly admixed.

Abdomen.—Dorsum with segment one covered with yellow pile, the remaining segments entirely black.

Wings.—Somewhat stained with brown; the hind pair subhyaline; the fore pair mostly subhyaline except in the region beyond the veins, this portion being distinctly brown.

Legs.—Black, often with touches of yellow pile on the trochanters or on the bases of the femora.

Worker—Much like the queen; head sometimes entirely black.

Male. Head.—Broad and rounded. Face with clypeus mostly bearing pure yellow pile, sometimes with black hairs admixed and with black and yellow hair mixed about the bases of the antennæ; occiput usually with a triangular patch of pure yellow pile, but sometimes with black hairs admixed; ventro-lateral portions of head with considerable yellow pile, this usually not connecting with the yellow on the occiput. Malar space about as long as its width at apex, about one-fifth as long as the eye. Clypeus mostly covered up with pile.

Flagellum of antenna about three times as long as the scape; third and fourth antennal segments subequal in length, the fifth considerably longer than either.

Thorax.—Coloration of pile much as in females, the lower portions of the metapleura with yellow pile and the sides of the median segment without any noticeable admixture of dark pile with the yellow.

Abdomen.—Dorsum colored as in the females. Venter variable, sometimes mostly dark and sometimes mostly clothed with pale yellow hair.

Genitalia.—Outer spatha much like that of *B. vagans* (fig. 131), but the posterior margin straight or somewhat incurved and the side margins somewhat broadly rounded. Inner spatha (fig. 133) quite variable, the median projection of its anterior margin heavily chitinized and widely and deeply emarginate in the middle; the posterior margin sometimes straight, as in the figure, and sometimes deeply indented so as to make the apex of the spatha strongly bilobate, the lobes having rather acute tips; a small rounded fenestra usually present on each side of the middle line at some distance behind the center. Claspers (figs. 62 and 72) with volsellæ noticeably widened somewhat beyond the middle; each squama with a very prominent shelf-like projection on its lower and inner side, the margin of this projection passing the inner margin of the squama; the branches very strongly widened at the end as seen from above. Sagittæ much as in *vagans*.

Wings.—Much like those of the worker.

Legs.—Coxæ, trochanters and femora usually with considerable yellow pile, but sometimes the coxæ and sometimes the femora entirely dark; fore and middle tibiæ sometimes entirely dark but often with some ferruginous hair on their sides; hind tibiæ with outer faces somewhat convex and naked, except for a very sparse scattering of hairs; corbicular fringes mostly dark, but the hind ones often tinged more or less with ferruginous; posterior metatarsi with rather long hind fringes, these fringes being mostly dark, but usually tinged more or less with ferruginous.

Dimensions.—Length: queen, 16 mm. to 20 mm.; worker, 9 mm. to 15 mm.; male, 11 mm. to 15 mm. Spread of wings: queen, 37 mm. to 40 mm.; worker, 20 mm. to 32 mm.; male, 22 mm. to 30 mm. Width of abdomen at second segment: queen, 9 mm. to 11 mm.; worker, 4½ mm. to 8 mm.; male, 5 mm. to 7 mm.

Redescribed from many specimens of each caste.

Habitat.—This species ranges throughout the entire eastern United States, except probably such Boreal regions as northern Maine, northern Michigan and the higher altitudes of the mountain ranges. It also ranges through southern Ontario, my most northern record being Ottawa. Bowles

has recorded it from Montreal in Quebec. My most western records are Logansport, Louisiana and Lincoln, Nebraska. These records seem to mark about the western limits of the species as Mr. Swenk (Ent. News, July, 1907, page 296) reports it from eastern Nebraska only, but it may possibly range as far west as the eastern slopes of the Rocky Mountains. It seems to be confined pretty strictly to the Transition and Upper and Lower Austral Zones, though it runs over into the Tropical Region somewhat in southern Florida. It is a common species throughout the greater portion of its habitat. I have no records from Texas, Oklahoma, Kansas or the Dakotas, but it seems probable that the species is present in at least the eastern parts of those states.

Nests.—I have taken several nests of this species and have known of their being taken by others and, as far as I have been able to ascertain, they are invariably subterranean and the colonies often consist of a very large number of individuals. The largest *Bombus* colony which I have ever taken belonged to this species, and was taken at Amherst, Mass., August 31, 1904. It contained three hundred and forty individuals, of which four were queens and fifteen were males. This nest was made of old grass and was located in an old mouse burrow two and one-half feet below the surface of the ground. It was very loosely constructed, the comb even not hanging together well when removed from the nest; in fact, the majority of the cells seemed to be entirely separate one from another. Of the three hundred and thirty unbroken cells found in the nest, one hundred and fifty-four were queen cells and the majority of the young inside them were still in the larval state. The queen cells were more or less foot-ball shaped and averaged about eighteen millimeters in length. The remaining cells varied considerably in size, being on the average a little more than one-half as long as the queen cells.

B. bimaculatus Cress. is by far the closest ally of this species. The females of these two species can always be readily separated by the difference in the length of their malar spaces and by the difference in the coloration of the pile on

the basal middle of their second dorsal abdominal segments. The males can also be easily distinguished by the latter character.

This species is quite generally known as *B. virginicus* (Olivier), but this name cannot be correctly used for it as I will here endeavor to show. In 1770, Drury described and figured (Illust. Ins., I, p. 96, Pl. 43, fig. 1) a species, without name, which, as the figure and description plainly show, was our common *Xylocopa*. Linnæus, in his "Mantissa Plantarum," published during the following year, gave the name *Apis virginica* to Drury's species. The following descriptions of *Apis virginica* down to Olivier's, as Cresson has shown (Proc. Ent. Soc. Phila., II, 1863, p. 89) are mere copies and quotations of these descriptions, the authors not having seen the insect. Hence, all these descriptions must be referred to the synonomy of *Xylocopa virginica*. Olivier's description of *Apis virginica*, however, appears to refer distinctly to this species of *Bombus*. Therefore, we see that two distinct species of insects have borne the name *Apis virginica*. If we apply the rule "once a homonym, always a homonym," it will be seen at once that the name *virginicus*, as used for this species, must be respected as a homonym and the next available name under which the species has been described be used in its stead. For this reason, I have used the name *impatiens* as the one which I consider proper for this species.

Bombus (Bombus) ternarius Say.

? *Bombus ternarius* Harris, Catal. Insects Mass., 1835, p. 70 (nom. nud.).
" " Say, Boston Journ. Nat. Hist., I, 4, 1837, p. 414, n. 3, ♂.
? " *ornatus* Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 398, n. 52, ♀ ☿ ♂ (pars.).
" *ternarius* Leconte, Edition of Writings of Th. Say Ent., II, 1859, p. 788, n. 3.
" " Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 172, n. 8, ♂.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 104, n. 34, ♀ ☿ ♂ (pars.).
? " *ornatus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 104, n. 33, ♀ ☿ ♂ (pars.).

Bombus ternarius Putnam, Proc. Essex Instit., IV, 1863, p. 99 (pars.).
" " Packard, Proc. Essex Instit., IV, 1864, p. 116, ♀ ☿ ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *ornatus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *ternarius* Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " Provancher, Natural. Canad., XIII, 1882, p. 267, n. 4, ♀.
" " Provancher, Faun. Entom. Canada. Hymen., 1883, p. 735, n. 4.
" *ornatus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *ternarius* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *ternarius* var. *ornatus* Ant. Handlirsch, Ann. natur. Hofmus. Wien., III, 1888, p. 230.
" " Dalla Torre, Cat. Hym., X, 1896, p. 553.
? " *ternarius* var. *ornatus* Dalla Torre, Cat. Hym., X, 1896, p. 553.
" " Harvey and Knight, Psyche, VIII, 1897, p. 79.
" " Cockerell, Bull. S. Cal. Acad. Sci., III, June, 1904, p. 89.
" " Jarvis, 36th Ann. Rep't Ent. Soc. Ont. (1905), p. 128.
? " " Cockerell, Can. Ent., XXXVIII, 1906, p. 160.
" *ornatus* Cockerell, Can. Ent., XXXVIII, 1906, p. 160.
" *ternarius* Lowell, Ent. News, XVIII, May, 1907, p. 197, ♂ ☿ ♀.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Types.—Lost.

Pile of medium length and rather coarse Head mostly dark; thorax mostly yellow, but with a broad black interalar band; abdomen with first and fourth dorsal segments yellow, second and third ferruginous-red and fifth and sixth black; corbicular fringes dark; wings moderately dark. Malar space short.

Queen. Head.—Trapeziform. Face with yellow pile above, between and below the bases of the antennæ; occiput sometimes entirely black, but usually with some yellow hair intermixed with the black; cheeks black. Labrum with tubercle-like areas large and well separated, their margins rather sharply elevated and summits rather deeply concaved; the space between these areas and above the shelf-like projection rather deeply excavated; shelf-like projection not very wide, but quite prominent; translucent spots faint or absent. Mandibles usu-

ally with no indication of a fourth tooth (fig. 42). Malar space considerably shorter than its width at apex; about one-sixth as long as the eye. Clypeus rather coarsely punctate. Flagellum of antenna about twice as long as the scape; third antennal segment longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile; a very broad black band between the bases of the wings, its posterior border extended backward, in a sharp median V, across, or nearly across, the scutellum, the remainder of the scutellum being covered with yellow pile; mesopleura covered with lemon-yellow pile to, or nearly to, the bases of the legs; metapleura with mostly yellow pile; sides of median segment often with only yellow pile, but usually with a more or less strong admixture of black hairs; center of disc naked, smooth and shining.

Abdomen.—Dorsum: segment one yellow on the sides, the very middle only scantily clothed with short, usually black, but sometimes ferruginous, hairs; segments two and three entirely ferruginous-red; segment four entirely yellow; segments five and six black. Venter mostly black, but with the fringes on the apical margins of some of the middle segments usually more or less yellow, especially on the sides. Hypopygium with no distinct median carina.

Wings.—Moderately stained with brown; the fore pair lightest across the middle portion and darkest in the region beyond the veins.

Legs.—The middle and hind trochanters and the bases of the middle and hind femora on their lower sides bearing a considerable amount of yellow pile; the legs, aside from this, dark, except the bases of the front femora sometimes with some yellow hair on their lower sides; corbicular fringes dark.

Worker.—Much like the queen, but the face and the occiput usually with less yellow pile, often entirely dark. The black band on the dorsum of the thorax often extending far forward, so as to leave only a narrow line of yellow across the anterior part. Wings usually somewhat lighter than those of the queen. Bases of middle and hind femora and the hind trochanters often entirely dark.

Male. *Head*.—Very broad. Face and occiput largely covered with yellow pile; ventro-lateral portions of head bearing a large amount of yellow pile, this often connecting with the yellow on the occiput. Malar space longer than its width at apex; about one-fifth as long as the eye. Clypeus mostly covered up with yellow pile. Flagellum of antenna, when viewed laterally, appearing strongly crenate on its lower side (fig. 23); about two and three-fourths times as long as the scape; third antennal segment slightly longer than the fourth, the fifth longer than the third.

Thorax.—Coloration much like that of the female, but with the interalar band narrower and less sharply outlined; mesopleura always yellow to the bases of the legs; metapleura and sides of median seg-

ment always with yellow pile; pile somewhat longer than that of the females.

Abdomen.—Dorsum colored much as in queen; apical segment black, but often with a noticeable amount of ferruginous hair on apical portion. Venter largely clothed with yellow pile, the apical margin of the apical segment fringed with ferruginous hairs.

Genitalia.—Outer spatha (fig. 137) short and wide, its side margins usually somewhat irregular; anterior lateral projections rather narrow and rounded at their ends; ventral surface of apical portion with a somewhat scattering tuft of rather long hairs on each side. Inner spatha (fig. 142) somewhat variable; lateral margins strongly and rather evenly incurved; posterior margin rather strongly curved forward in the middle, making the apex distinctly, though not strongly, bilobed; an elongate fenestra on each side of the middle line of the apical portion; ventral surface of apical portion rather densely hairy on each side and also, to a considerable extent, in the middle between the fenestræ. Claspers (fig. 65) and sagittæ, for the most part, as already described for the group; the inner margin of each squama broadly incurved; the shafts of the sagittæ bent outward somewhat in the middle.

Wings.—Usually somewhat lighter than those of the worker, distinctly lighter than those of the queen, subhyaline.

Legs.—Coxæ, trochanters and femora bearing much yellow pile; fore tibiæ mostly black, but usually with a few ferruginous hairs near their tips; middle tibiæ usually with a large amount of ferruginous pile, especially on their posterior sides; hind tibiæ with outer faces convex; corbicular areas bare, except for a few short scattered hairs; corbicular fringes mostly light ferruginous; hind fringes of posterior metatarsi rather short and mostly light colored.

Dimensions.—Length: queen, 14 mm. to 17 mm.; worker, 8 mm. to 13 mm.; male, 10 mm. to 13 mm. Spread of wings: queen, 31 mm. to 35 mm.; worker, 17 mm. to 27 mm.; male, 22 mm. to 27 mm. Width of abdomen at second segment: queen, $8\frac{1}{2}$ mm. to 9 mm.; worker, 4 mm. to $7\frac{1}{2}$ mm.; male, 5 mm. to 7 mm.

Redescribed from numerous specimens of all the castes.

Habitat.—I have records of this species from parts of the United States as follows: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania (Jeannette), West Virginia, Wisconsin (Polk County and Grand Rapids), Minnesota (Minneapolis, St. Paul and Lake Itasca), South Dakota (Bigstone), North Dakota (Tower City). My Canadian records are as follows: Prince Edward Island (Hampton), Quebec (Montreal and Saguenay River), On-

tario (Ottawa), Manitoba (Winnipeg), the new province of Saskatchewan (Oxbow, Regina, Carnduff and Prince Albert) and Alberta (St. Albert and Macleod). What are its southern limits in the Appalachian Mountain system and in the Central States and its northern limits in Canada? In western Canada it probably does not reach far beyond the eastern slopes of the Rocky Mountains. It must be present in New Brunswick, Rhode Island and Michigan. Say, in his original discussion of the species, says it "Inhabits Indiana." I know of no other record for it from the Upper Austral Zone and this leads me to question the correctness of Say's statement. No other species of *Bombus*, known to me, answers Say's description in all respects. It appears to be confined pretty strictly to the Canadian and Transition Zones and is one of the rarer forms throughout the greater part of its range of habitat, though Prof. C. H. Fernald tells me it is one of the most common species in southern Maine. A specimen in the collection of the Massachusetts Agricultural College, which I have been unable to determine as anything else than a worker of this species, was collected, as Mr. C. C. Gowdey, a former student in the Massachusetts Agricultural College, tells me, by himself in Barbados, British West Indies. It seems, however, as though there must be some mistake about this.

Nests.—I have not taken any nests of this species, but, judging from Putnam's account, it seems probable that the nests are usually built in structures, such as hollow stumps or trees or in the walls of buildings.

This species has its closest allies in: *sylvicola*, from which it can be readily separated by its much shorter pile; *huntii*, from which it can be separated by its much darker head, by the median V-like projection of the hind border of its interalar band and by the difference in structure of the flagellum of the antenna of the male; *edwardsii*, from which it can be separated by its much darker head and black corbicular fringes.

The ferruginous pile on the second and third segments is sometimes very much faded, so as to appear strongly yellowish.

Bombus (Bombus) huntii Greene.

Bombus huntii Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 172, n. 10, ♀.
" *ternarius* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 104, n. 34, ♀ ☿ ♂ (pars.).
? " " Packard, Proc. Essex Instit., IV, 1864, p. 116 (pars.).
? " " Cresson, Rep. Geogr. and Geol. Explor. and Sur. 100th Merid., V, 1875, p. 728, n. 132, ♂.
? " " Putnam, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 189.
? " " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 230 (pars. (a)).
" " Dalla Torre, Cat. Hym., X, 1896, p. 553 (pars.).
" " Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
? " " Cockerell and Porter, Ann. and Magaz. of Nat. Hist. Ser. 7, IV, Nov., 1899, p. 390.
" " Cockerell, Psyche, IX, 1901, p. 163, ♀.
" " Cockerell, Entomologist, XXXII, June, 1899, p. 156.
" " Titus, Can. Ent., XXXIV, 1902, pp. 38 and 42, ♂ ☿ ♀.
? " " Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" " Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" " Howard, Insect Book, 1904, Plate I, fig. 26, ♀.
" *rufosuffusus* Cockerell, Ent. News, XVI, Oct., 1905, p. 271.
" *huntii* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 312.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, pp. 419 and 453, n. 115.
" *rufosuffusus* Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1006, p. 453, n. 118.
" *huntii* Swenk, Ent. News, XVIII, July, 1907, p. 297, n. 7.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" *rufosuffusus* Cockerell, ibid., p. 258.
" *huntii* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 16.

Type.—Apparently lost. I have not seen the type *B. rufosuffusus* Ckll., but I have placed *rufosuffusus* in the synonomy of *huntii* on the basis of Prof. Cockerell's own comparison,

with this type, of specimens which I have sent him. I sent him a nearly typical queen *huntii*, giving it the label number "33," and he writes, after pointing out slight differences between this specimen and the *rufosuffusus* type, as follows: "33 is, I think, really *rufosuffusus;* whether a variation or a geographical race cannot be determined without more material." As *huntii* varies a little in most of the characters pointed out, I have not the least doubt that the two species are the same.

Pile of medium length and rather coarse. Face and occiput yellow; thorax mostly yellow, but with a black band between the wings with its hind border nearly straight. Dorsum of abdomen with first and fourth segments yellow, second and third ferruginous-red, fifth and sixth black (in the females). Females with legs dark and corbicular fringes black. Malar space of medium length.

Queen. Head.—Slightly elongate. Face largely covered with rather dense yellow pile; occiput with a large triangle of yellow pile; cheeks black. Labrum with tubercle-like areas large and well separated, their summits rather strongly concaved and margins rather sharply elevated; space between these areas and above the shelf-like projection deeply excavated; shelf-like projection rather narrow, but prominent; translucent spots usually plainly visible to the naked eye. Mandible, at most, with only a slight indication of a fourth tooth (resembling *ternarius* in this respect). Malar space somewhat shorter than its width at apex, about one-fifth as long as the eye. Clypeus coarsely but rather sparsely punctate. Flagellum of antenna somewhat less than twice as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Dorsum covered with yellow pile, except for a black band between the bases of the wings, the hind margin of this band not extending back onto the scutellum in the middle; mesopleura mostly covered with yellow pile, but the yellow not reaching the bases of the legs and often coming considerably short of it, sometimes nearly the whole lower half black; metapleura and sides of median segment often bearing very little but dark pile, but often with nearly pure yellow pile; center of disc naked, smooth and shining.

Abdomen.—Dorsum: segment one yellow; segments two and three ferruginous-red; segment four yellow; segments five and six black. Venter mostly black, but with the sides of the apical margins of some of the middle segments fringed with yellow hairs, especially of segments three and four.

Wings.—Rather strongly, but not deeply, stained with brown; the fore pair lightest across the middle and darkest in the median and sub-

median cells, in the anterior portion of the radial cell and in the region beyond the veins.

Legs.—Black and with corbicular fringes black, rarely with a few light hairs at the bases of some of the femora.

Worker.—Much like the queen, but with wings usually somewhat lighter, in many cases almost subhyaline; mesopleura usually covered with yellow pile to the bases of the legs; metapleura and sides of median segment usually yellow.

Male. Head.—Triangular in outline as viewed from in front. Face, occiput and cheeks mostly clothed with dense yellow pile, the yellow on the cheeks connected with that on the occiput. Malar space distinctly longer than its width at apex. Clypeus covered up with dense, pure yellow pile. Flagellum of antenna about two and three-fourths times as long as the scape; third antennal segment and fifth subequal in length, the fourth shorter than either.

Thorax.—Coloration of pile much like that of worker, but the black interalar band rather narrower and less sharply defined; pleura always well covered with yellow pile to the bases of the legs; metapleura and sides of median segment always yellow.

Abdomen.—Dorsum: segment one yellow; segments two and three ferruginous-red; segments four and five yellow, but sometimes with black hairs admixed in the middle; segments six and seven black. Venter with the apical margins of the segments fringed for the most part with yellow pile.

Genitalia.—Outer spatha variable, but usually much like that of *ternarius* (fig. 137); the hind border sometimes deeply incurved so as to make the apex bilobate. Inner spatha variable, but in general much like that of *ternarius* (fig. 142); fenestræ sometimes entirely absent. Claspers and sagittæ much like those of *ternarius* (fig. 65), but the volsellæ much narrower throughout their entire length. Shafts of sagittæ rather strongly bent outward in the middle as in *ternarius*.

Wings.—Subhyaline; about like those of the worker.

Legs.—Coxæ, trochanters and femora all bearing a considerable amount of yellow pile; fore tibiæ dark; middle tibiæ mostly dark, but often with some ferruginous hair on their hind sides; fringes of hind tibiæ usually more or less yellowish or ferruginous. Outer faces of hind tibiæ somewhat convex and mostly naked. Posterior metatarsi with short, dark or ferruginous hind fringes.

Dimensions.—Length: queen, 14 mm. to 19 mm.; worker, 9 mm. to 13 mm.; male, 11 mm. to 12 mm. Spread of fore wings: queen, 36 mm. to 37 mm.; worker, 20 mm. to 28 mm.; male, 25 mm. to 27 mm. Width of abdomen at second segment: queen, $8\frac{1}{3}$ mm. to 10 mm.; worker, $4\frac{1}{2}$ mm. to 6 mm.; male, $5\frac{1}{2}$ mm. to $6\frac{1}{2}$ mm.

Redescribed from numerous specimens of each caste.

Variation.—This is one of the most constant species in all its characters. The ferruginous pile on the second and third dorsal abdominal segments has a considerable tendency to fade out into yellow, and this has led to the females having been sometimes labelled "*Bombus fervidus*" in collections.

Habitat.—This species ranges through Washington, Idaho, Montana, Oregon, Wyoming, California (except probably their Lower Austral portions), Nevada, Utah, Colorado and a considerable portion of New Mexico. It also occurs in western Nebraska, western South Dakota, probably in western North Dakota and parts of Arizona and possibly in the extreme western portions of Oklahoma and Texas. I have records of it from Canada as follows: Vancouver Island, British Columbia (Fort Macleod), Alberta (Macleod) and the old territory of Assiniboia (Regina). What are its most northern and eastern limits in Canada? My most southern record is Mescaleri, New Mexico. The species belongs mainly to the Transition Zone, but it runs over somewhat into the Canadian on one side and the Upper Austral on the other. In certain parts of its habitat it is the most common species present, especially so in Colorado.

This species is most closely allied to *B. edwardsii*, from which it can always be separated by the black corbicular fringes of the females and by the straight hind border of the interalar band. Its next closest ally seems to be *B. vosnesenskii*, from which it is at once separated by its coloration. It is a little more distantly related to *B ternarius*, from which it is easily separable by means of its yellow face and occiput and longer malar space, also by the more completely black legs and the straight hind margin of the interalar band of its females. The volsellæ are more slender than those of the *ternarius* male and the flagellum of the male antennæ does not appear crenate below, when viewed laterally, as it does in that species. It is also closely allied to *sylvicola*, but it has much shorter pile than does that species.

This is the species which has long passed in the West as *B. ternarius* Say, but true *ternarius* is not present in any of the Pacific States.

I cannot tell with absolute certainty from Greene's description whether he was describing this species or the extreme red form of *B. edwardsii*, but, as the description seems to apply to the form above described, I am adopting the name *huntii* for this species. If Greene's description should be considered too uncertain to allow the retention of the name *huntii*, then the name *rufosuffusus*, given by Cockerell, would have to be recognized as the proper name for the species.

Bombus (Bombus) fernaldi Franklin.

Bombus edwardsii Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317 (misidentification).

" *fernaldi* Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 157, ♀ ☿ ♂.

The specimens from which, Fowler made his description of this species (Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317), having mistaken it for *edwardsii*, may be looked upon as the type specimens. Can those specimens be identified with certainty?

Pile of medium length and rather fine. Face and occiput with much yellow pile; thorax, except for a usually broad black interalar band, clothed with yellow pile; dorsum of abdomen with basal segment yellow, segments two and three usually entirely black, four and five largely yellow and the apex usually black. Corbicular fringes of females dark.

Queen. Head.—Wide for its length. Face mostly covered for some distance above and below the bases of the antennæ with a patch of pure yellow pile; occiput with a median triangular patch of yellow pile with a slight admixture of black hairs; cheeks dark. Labrum with tubercle-like areas having their posterior (proximal) margins rounded and their summits flat or concaved, the region between them and above the shelf-like projection rather deeply excavated; the shelf-like projection not prominent. Malar space fully as long as its width at apex; between one-fifth and one-fourth as long as the eye. Clypeus sparsely and coarsely punctate over the disc; the corners densely and coarsely punctate. Flagellum of antenna about twice as long as the scape; the third antennal segment much longer than the fifth, the fourth and fifth subequal in length.

Thorax.—Anterior part of the dorsum covered with yellow pile, often with a very slight sprinkling of black hairs admixed; a very broad and well defined black band present between the bases of the wings, its hind border straight or curved backward slightly in the middle; center of the disc naked; scutellum covered with yellow pile; mesopleura

yellow to the bases of the legs; metapleura clothed with yellow pile; sides of median segment usually with dark and yellow pile mixed.

Abdomen.—Dorsum: segment one yellow; segments two and three black; segment four yellow, but often with some black hairs in the very middle; segment five with considerable black pile in the middle, this very often sprinkling out somewhat strongly through the yellow pile on the sides; segment six dark. Venter largely dark, but with the sides of the apical margins of the second to the fifth segments inclusive fringed more or less heavily with yellow hairs; the middle portion of the apical margin of the first segment also often with a yellow fringe. Hypopygium without a median carina.

Wings.—Somewhat stained with brown; the fore pair darkest along the costal border.

Legs.—Fore and middle coxæ mostly dark; hind coxæ with some yellow hairs on their outer sides; fore trochanters mostly dark; middle and hind trochanters with considerable yellow pile on their lower sides; fore femora sometimes with a few yellow hairs on their lower sides; middle femora sometimes entirely dark and sometimes with considerable yellow pile on their lower sides; hind femora always with more or less yellow hair and sometime with more yellow than black; fore and middle tibiæ and corbicular fringes dark.

Worker.—Much like the queen, but often with a strong admixture of black hairs with the yellow on the front part of the dorsum of the thorax; middle trochanters and hind femora occasionally entirely dark and the hind trochanters sometimes with only a very little yellow pile; the metapleura sometimes with considerable dark pile and the sides of the median segment occasionally entirely dark.

Male.—Face and occiput largely covered with pure yellow pile; cheeks with much yellow pile, usually connecting with the yellow on the occiput. Malar space longer than its width at the apex, nearly one-fourth as long as the eye. Clypeus mostly covered up with yellow pile. Flagellum of antenna nearly three and one-third times as long as the scape; third antennal segment somewhat shorter than the fifth, the fourth shorter than the third.

Thorax.—Coloration much like that of the queen and worker, but the black interalar band usually distinctly narrower.

Abdomen.—Dorsum: segment one yellow; segment two usually mostly black, but its basal middle usually with more or less yellow pile, this pile sometimes extending to the hind margin of the segment; segment three black; segment four yellow, but usually with a little black pile in the very middle; segment five like segment four, but usually with more black pile in the middle; segments six and seven black. Venter, except at the base, clothed mostly with yellow pile.

Genitalia.—Outer spatha much like that of *vagans* (fig. 131). Inner spatha much like that of *impatiens* (fig. 133). Claspers (figs. 74 and 110) with inner sides of the ends of the branches rather sharply pointed as viewed from above; the volsellæ with prominent apical projections.

Wings.—Much like those of the queen and worker.

Legs.—Coxæ, trochanters and femora with much yellow hair; fore and middle tibiæ mostly dark; hind tibiæ with outer faces slightly hairy, their fringes usually with more or less pale ferruginous hairs; hind metatarsi with long, pale ferruginous hind fringes.

Dimensions.—Length: queen, 13½ mm. to 15 mm.; worker, 10 mm. to 12 mm.; male, 10 mm. to 12 mm. Spread of wings: queen, about 34 mm.; worker, 22 mm. to 31 mm.; male, 22 mm. to 27 mm. Width of abdomen at second segment: queen, about 9 mm.; worker, 6 mm. to 8 mm.; male, 4½ mm to 7 mm.

Redescribed from three queens, seventeen workers and seven males.

Habitat.—Most of my records for this species are Californian, as follows: Santa Clara County, Lake County, Nevada County, San Jose County, Mendocino, Sonoma County, Palo Alto, Yosemite. I have seen one worker from Nevada. It seems to be a common species in California, at least in some localities.

This species apparently has its closest ally in *huntii*, from which it can be at once separated by the different coloration of the dorsum of its abdomen. *Edwardsii* and *vosnesenskii* are also closely related. From *edwardsii* it can be readily separated by means of its dark corbicular fringes and by the nearly straight hind border of its black interalar band and from *vosnesenskii* by its strikingly different coloration.

The species is a rather pretty one, the yellow pile being very bright and contrasting sharply with the black.

Bombus (Bombus) vosnesenskii Rad.

Bombus californicus Smith, Catal. Hym. Brit. Mus., II, 1854, p. 400, n. 57, ♂ (not the ♀).

" *vosnesenskii* Radoszkowski, Bull. Soc. natural. Moscou, XXXV, P. 2, 1862, p. 589, n. 13, ♀ ♂; T. 6, F. 1.

" *californicus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 97, n. 18, ☿ ♂ (not the ♀).

" *flavifrons* Smith, Lord, Natural. in Vancouver Island, II, 1866 (appendix), p. 343.

" *californicus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (pars.) (Catal.).

" " Cresson, Syn. Hym. No. Amer., 1887, p. 307 (pars.) (Catal.).

" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 243, ☿ ♂.

Bombus columbicus Dalla Torre, Wien. entom. Zeitg., IX, 1890, p. 139.
" *californicus* Dalla Torre, Cat. Hym., X, 1896, p. 513 (pars.).
" sp. Jordan and Kellogg, Animal Life, 1900, p. 161, fig. 96.
" *columbicus* Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p. 89.
" sp. Kellogg, American Insects, 1905, p. 519, fig. 724 and fig. 723.

Types.—Male taken in California (described by Smith as *californicus*), in the collection of the British Museum; queen, location not known to me; worker (described as *californicus* by Cresson), in the collection of the American Entomological Society.

Pile rather short and dense. Face, occiput, anterior part of dorsum of thorax and fourth dorsal abdominal segment covered with yellow pile; the rest of the body bearing only black pile; wings very dark. Malar space rather short.

Queen. Head.—Broadly triangular; face heavily covered with pure yellow pile, the yellow nearly reaching the inner margins of the eyes on either side, covering the base of the clypeus below and extending above onto the lower part of the vertex; occiput well covered with a broad triangular patch of pure yellow, the front hairs of this patch and the upper ones of the facial patch meeting somewhat over the ocelli and partially concealing them; remainder of head bearing only black hair, except a little of ferruginous color borne by the mouth parts. Labrum much as in *californicus*, translucent areas indistinct or absent; malar space not as long as it is wide at the apex, not more than one-fifth as long as the eye; clypeus moderately punctate; third antennal segment considerably longer than fifth, fifth somewhat longer than fourth.

Thorax.—Anterior part of dorsum covered with pure yellow pile; remainder, including pleura from about the level of the bases of the wings, entirely black; center of disc naked, smooth and shining.

Abdomen.—Entirely black, except the fourth dorsal abdominal segment, this being covered with pure yellow pile. Hypopygium without median carina.

Wings.—Very dark brown with slight violaceous reflections; forewings lightest in the apical portion, beyond the veins.

Legs.—Coxæ, trochanters, femora, fore and middle tibiæ and corbicular fringes all black. Posterior metatarsi bearing only short spines and pubescence, except for a fringe of short hairs on the basal portion of the posterior border.

Worker.—Like the queen, but usually with considerably lighter wings; translucent areas of labrum often large enough to be faintly visible to the naked eye.

Male. Head.—Shaped like that of queen; coloration of pile much like that of queen, but often with considerable yellow hair on the sides behind the eyes. Labrum like that of *affinis* male; malar space between one-fifth and one-fourth as long as the eye; clypeus usually well covered up with pile; fifth antennal segment distinctly longer than third, third distinctly longer than fourth.

Thorax.—Coloration of pile much as in queen, but usually with some yellow pile on the mesopleura below the level of the bases of the wings and with a distinct touch of yellow on their extreme lower part, next to the bases of the legs.

Abdomen.—Coloration of pile much like that of queen, but the fifth dorsal segment often with considerable yellow on the sides and along the apical margin and the venter usually bearing light hair for the most part.

Genitalia.—Outer spatha quite variable, but usually about like that of *B. vagans* F. Sm. (fig. 131). Inner spatha variable, sometimes with two and sometimes with no fenestræ, usually shaped about like that of *B. ternarius* Say (fig. 142). Branches of claspers with very wide apices (as seen from above), each extending inward in a very strong and rounded or very slightly pointed projection. Shafts of sagittæ bent outward noticeably at about the middle. Genitalia as a whole about like those of *B. ternarius* (fig. 65), but with squamæ much wider toward the apex, broadly rounded at the end and not so strongly incurved on the inner side.

Wings.—Distinctly lighter, as a rule, than either those of the queen or worker; as light in the veined area as beyond it.

Legs.—Coxæ black; trochanters often all black, but usually with a more or less strong sprinkling of light hairs; femora often all black but as often with more or less light pile on their basal part; fore and middle tibiæ and outer faces of hind tibiæ all black. Outer faces of hind tibiæ convex and very scantily hairy in the middle portion toward the apex, but actually bare on only a very small portion. Posterior metatarsi bearing only short spines and pubescence, except for a posterior fringe of moderately long hairs.

Dimensions.—Length: queen, 14 mm. to 19 mm.; worker, 9 mm. to 14 mm.; male, 10 mm. to 14 mm. Spread of wings: queen, 31 mm. to 42 mm.; worker, 19 mm. to 31 mm.; male, 23 mm. to 30 mm. Width of abdomen at second segment: queen, 8 mm. to 11 mm.; worker, 5 mm. to 8 mm.; male, 5 mm. to 7 mm.

The color characters of this species are very constant.

Redescribed from a large number of specimens of each sex.

Habitat.—I have records of this handsome species from California, Oregon, Washington and Ormsby County in ex-

treme western Nevada. It appears to be confined mainly to California, the western portion of Oregon and the southwestern portion of Washington. It probably is not found either north or east of these states or in eastern Nevada or Arizona, but is probably present in the northern part of Lower California (my most southern record is San Diego, California). It reaches its maximum abundance in California, where it appears, at least in some portions of the state, to be the most common species. It seems to belong mainly to the Pacific coast portion of the Transition Zone, not crossing the Sierra Nevada Range to any great extent.

This species appears to have its closest allies in *B. fernaldi* Franklin and *B. huntii* Greene, from both of which it is easily separated by its strikingly different coloration.

Bombus (Bombus) edwardsii Cress.

? *Bombus ternarius* Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210; also Putnam on p. 189.

" *edwardsii* Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 184, ☿ and ♂ (not the ♀).

" *bifarius* Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 185, ♀ ☿.

" *vancouverensis* Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 187, ♂ (pars.).

" " Cresson, Trans. Amer. Ent. Soc., VII, p. 231, 1879. (Catal.).

" *bifarius* Cresson, Trans. Amer. Ent. Soc., VII, p. 231, 1879. (Catal.).

" *edwardsii* Cresson, Trans. Amer. Ent. Soc., VII, p. 231, 1879 (pars.). (Catal.).

" *bifarius* Cresson, Syn. Hym. No. Amer., 1887, p. 307.

" *edwardsii* Cresson, Syn. Hym. No. Amer., 1887, p. 308 (pars.).

" *vancouverensis* Cresson, Syn. Hym. No. Amer., 1887, p. 308.

" *ternarius* var. *lacustris* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 230.

" *nearcticus* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 243 ♀ ☿ ♂.

" *edwardsii* Dalla Torre, Cat. Hym., X, 1896, p. 518 (pars.).

" *nearcticus* Dalla Torre, Cat. Hym., X, 1896, p. 538.

" *ternarius* var. *lacustris* (Ant. Handlirsch) Dalla Torre, Cat. Hym., X, 1896, p. 553.

" *vancouverensis* Dalla Torre, Cat. Hym., X, 1896, p. 560.

Bombus ternarius Cockerell and Porter, Ann. and Magaz. of Nat. Hist., Ser. 7, Vol. IV, Nov., 1899, p. 390.
" *bifarius* Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43, ♀ ☿ ♂.
" *nearcticus* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 127.
? " *ternarius* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" *ternarius* var. *bifarius* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" *cooleyi* Morrill, Can. Ent., XXXV, 1903, p. 222.
" *bifarius* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *nearcticus* Ashmead, Hym. of Alaska, 1904, p. 133.
? " *edwardsii* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 100.
" *vancouverensis* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *bifarius* Howard, Insect Book, 1904, Plate II, fig. 9, ♀.
" *bifarius* Cockerell, Can. Ent., XXXVIII, 1906, p. 160.
" *edwardsii* Cockerell, The Entomologist, XL, 1907, p. 97.
" *edwardsii* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.
" *bifarius* Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" *edwardsii* Cockerell, Univ. Color. Studies, IV, 1907, p. 258.
" *bifarius* Cockerell, Can. Ent., XLII, 1910, p. 25.
" *edwardsii cooleyi* Cockerell, Can. Ent., XLII, 1910, p. 25.
? " *edwardsii* Davidson, Bull. So. Cal. Acad, Sci., X, 1911, p. 66 (possibly *fernaldi*).

Types.—Worker and male in collection of American Entomological Society. Queen (described by Cresson as *bifarius*) in the same collection.

Pile of medium length, rather coarse. Face and occiput yellow; thorax mostly yellow or whitish with a broad black interalar band; first and fourth dorsal abdominal segments entirely covered with yellow pile; two apical segments black; corbicular fringes strongly ferruginous; malar space short.

Queen. Head.—Somewhat rounded trapeziform. Face with a large patch of pure whitish-yellow pile extending above and below the bases of the antennæ, this patch not reaching the inner margins of the eyes on either side; occiput with median triangular whitish-yellow patch of pile usually without black intermixed, but sometimes with a few black hairs present among the yellow; sides behind eyes black. Tubercle-like areas of labrum rather sharply and deeply concaved at summit the concave area nearly smooth; median shelf-like projection moderately broad; translucent areas large enough to be faintly visible

to naked eye. Malar space wider at apex than long, less than one-fifth as long as the eye; clypeus moderately and rather coarsely punctate; flagellum of antennæ not more than twice as long as the scape; third antennal segment much longer than fifth, fifth somewhat longer than fourth.

Thorax.—Anterior part of dorsum covered with whitish-yellow pile, sometimes with a slight admixture of black hairs; sides of scutellum pale yellow, sometimes with some black hairs intermixed; a broad black band between the bases of the wings, its posterior border extending backward in the middle across the scutellum; mesopleura covered with yellow pile for about half the way from the bases of the wings toward the bases of the legs, the lower part being entirely dark; lower part of metapleura always dark, upper part sometimes dark and sometimes yellow; sides of median segment with black or yellow pile or black and yellow pile mixed. Middle of disc naked, smooth and shining.

Abdomen.—Dorsum: segment one covered with yellow pile on the sides, but dark and nearly bare in the middle; segment two covered with ferruginous-red pile, except basal middle, this being black; segment three covered with ferruginous-red pile; segment four covered with yellow pile; segment five entirely black, except the apical margin usually with a fringe of yellow hairs; segment six black. Venter with apical margins of all the segments, except the first and last, fringed with light yellow hair. Hypopygium without distinct median carina.

Wings.—Slightly stained with brown; fore wings darkest on median and submedian cells and about the tip of the radial cell and often also on the region beyond the veins.

Legs.—Coxæ usually entirely black, sometimes with a few yellow hairs at tips; trochanters occasionally entirely black, but usually with a noticeable amount of light hair on the lower side; fore femora usually entirely black, at most with but very little light pile at bases; middle femora mostly black, but usually with some light hair at the base on the lower side; posterior femora almost always with considerable light pile on the basal two-fifths of the lower side and very often with a touch of yellow hair on the outer side near the distal end; fore and middle tibiæ mostly black, but usually with considerable ferruginous hair on hind sides, especially toward the apices; corbicular fringes always strongly ferruginous, sometimes with black hairs mixed in.

Worker. Head.—Much like that of queen, but with pile on face and occiput very light, almost white, and sometimes with a slight admixture of black hairs.

Thorax.—Coloration much like that of queen, but the yellow pile very light, almost white, and the pleura often covered with light pile to the bases of the legs; metapleura often entirely covered with light pile; sides of median segment usually covered with the same light pile, but sometimes with only dark pile.

Abdomen.—Dorsum: first segment almost destitute of pile in the middle, the sides covered with whitish hair; second segment usually entirely covered with black pile, sometimes with light yellow on basal middle; third segment usually entirely black; fourth segment sometimes with basal portion black, but usually entirely light yellow; two apical segments black. Venter with apical margins of segments fringed with pile of same color as that of queen.

Wings.—Subhyaline; sometimes lighter than those of queen.

Legs.—Fore legs almost entirely black; middle coxæ, trochanters and bases of femora usually with a very small amount of light hair, sometimes entirely dark; middle tibiæ dark; hind coxæ, trochanters and bases of femora on lower side usually with a very noticeable amount of light hair; corbicular fringes more or less strongly ferruginous, usually with an admixture of black hairs of varying amount; anterior and middle tibiæ dark.

Male. Head.—Shaped much as in female; face covered with a large patch of usually pure pale yellow pile, this patch very nearly reaching the inner margins of the eyes on either side; occiput bearing a triangular patch of usually pure pale yellow pile; sides of head, behind eyes, with a large amount of yellow pile. Margin of labrum usually but very slightly incurved in front; malar space distinctly less than one-fourth as long as the eye; clypeus well covered up with yellow pile; flagellum of antennæ a little less than two and one-third times as long as the scape; third and fifth antennal segments subequal in length, the fourth somewhat shorter than either.

Thorax.—Much like that of worker in coloration, but with pleura always yellow to bases of legs, metapleura always entirely covered with yellow pile and sides of median segment having at most not a very strong admixture of black hairs with the yellow on the sides; black interalar band somewhat narrower than that of worker and less sharply defined.

Abdomen.—Dorsum: segment one covered with yellow pile; segment two with basal middle yellow, the rest black; segment three often entirely black, but usually with considerable yellow pile on the sides, especially near the apical margin; segment four entirely covered with yellow pile; segment five often entirely yellow, but as often with considerable black hair on the middle apical portion; segments six and seven usually entirely black, but sometimes with a very slight sprinkling of yellow hairs mixed with the black. Venter rather sparsely clothed with light pile.

Genitalia.—Spathæ variable, but usually much like those of *B. ternarius* Say (figs. 137 and 142). Claspers like those of *B. ternarius* (fig. 65), but with squamæ more suddenly wider at the base so as to be very distinctly notched on the inner side instead of being evenly incurved. Sagittæ and uncus as in *ternarius*.

Wings.—About like those of workers.

Legs.—Coxæ, trochanters and femora bearing a large amount of yellow pile, in most cases mainly clothed with it; fore and middle tibiæ mostly black, but with a usually strong posterior fringe of ferruginous pile of varying shade; posterior tibiæ with outer faces convex and naked, in some specimens with a few scattered hairs, anterior fringes rather short and posterior ones long, thus forming the distinct, but weak, corbiculæ; hind metatarsi with rather long posterior fringes.

Dimensions.—Length: queen, 13 mm. to 17 mm.; worker, 9 mm. to 12 mm.; male, 10 mm. to 12 mm. Spread of wings: queen, 31 mm. to 35 mm.; worker, 19 mm. to 31 mm.; male, 24 mm. to 26 mm. Width of abdomen at second segment: queen, 7½ mm. to 9 mm.; worker, 4½ mm. to 7½ mm.; male, 5 mm. to 6 mm.

Redescribed from three queens (one of them a homotype of *bifarius* Cress.), eight workers and eight males.

Variations.—With the exceptions of *rufocinctus* Cress., *californicus* Smith, *occidentalis* Greene and *pleuralis* Nylander this is the most variable species of *Bombus* in North America. I have had a very large series of specimens and have been able to make out a complete intergradation between the folfowing forms, which seem well marked enough to deserve separate description.

Color Variant 1.—(*bifarius* Cresson). Queen, typical described above and worker like it. Specimens from Colorado, Utah and New Mexico.

Color Variant 2.—(*cooleyi* Morrill, pars.). Queen and worker like the typical queen, but with the anterior two-thirds of the second dorsal abdominal segment entirely covered with black pile and a sharp median v-like projection of the same color extending backward from this across, or nearly across, the third segment; sides of the posterior portion of the second segment and sides of the third segment covered with ferruginous-red or yellowish-ferruginous (of greatly varying shade) pile; yellow pile on thorax very light, almost white. Numerous specimens from Montana and Utah.

Color Variant 3. -(*cooleyi* Morrill, pars.). Queen and worker like Color Variant 2, but with second dorsal abdominal segment bearing only a touch of light yellowish-ferruginous pile on the sides of the apical portion and with segment three having the anterior half covered with black pile; mesopleura covered with yellow pile nearly to bases of legs. Several specimens from Montana.

Color Variant 4.—Queen and worker like Color Variant 3, but with second dorsal segment entirely black and third segment bearing ferru-

ginous pile only on its apical margin. Numerous specimens from British Columbia and Montana.

Color Variant 5.—(*nearcticus* Ant. Handlirsch and *cooleyi* Morrill, pars.). Queen and worker like Color Variant 2, but with dorsal segments two and three entirely black—typical worker (*edwardsii* Cresson). Numerous specimens from British Columbia, Montana and Alaska.

Male Color Variant 1.—(*edwardsii* Cresson). The typical form described above. Many specimens from British Columbia and Montana.

Male Color Variant 2.—(*vancouverensis* Cresson, pars.). Like Male Color Variant 1, but with sides of dorsal segment three bearing ferruginous pile. Four specimens from British Columbia.

Male Color Variant 3.—Like the first two male color variants, but with the second and third dorsal abdominal segments entirely covered with ferruginous-red pile. Specimens from British Columbia and Colorado.

Male Color Variant 4.—Like Male Color Variant 1, but with second dorsal abdominal segment entirely covered with yellow pile. Two specimen from California.

While I have not seen enough material from all parts of the habitat of this species to be sure of my ground, I believe that sufficient collecting is likely to show that those color variants with the second and third dorsal abdominal segments largely covered with ferrugionus-red pile are much more numerous in the southern part of its range (Colorado, Utah, Nevada, California and New Mexico) while those color variants which have these segments mostly black are much more numerous in the northern part (Alaska, British Columbia, Alberta, Mantana, etc.)—this is evidenty the case in Montana and Colorado and only the *nearcticus* form has been taken in Alaska. As will be seen, this apparent characteristic is closely paralleled in the case of *flavifrons* and *rufocinctus*.

Habitat.—I have records of this species from Alaska (southern), British Columbia, Alberta, Vancouver Island, Washington, Idaho, Montana, California, Nevada, Utah, Colorado and New Mexico. It must be present also in Oregon and Wyoming. My most northern record is Juneau, Alaska; most eastern, Garden of the Gods, Colorado; most southern, Beulah, New Mexico. In our western states, it

appears to be confined mainly to the mountain chains and it must be considered a Boreal Region (possibly also a somewhat Transition Zone) form. It probably is not to be found much farther south or east than the records above given. How far north does it range and how far east in Canada? It seems to be rare in Alaska and to increase in abundance southward, reaching its maximum through western Montana. It seems to be rather common on the higher lands of Colorado.

This species has by far its closest allies in *fernaldi*, *ternarius*, *vosnesenskii* and *huntii*. Of these, *huntii* is apparently the nearest, and they often resemble each other not a little in coloration, but they can be instantly separated by the difference in form of the posterior border of the black interalar band and by the striking difference in the color of the corbicular fringe. *B. ternarius*, with its structurally different male antennæ, is evidently much less closely allied than is *vosnesenskii*. It is interesting to note that, of these five closely allied forms, the four with yellow faces are also structurally the most alike, though differing otherwise remarkably in coloration.

This species and *rufocinctus* have probably caused the workers on the Bombidæ of North America more trouble than most others.

I have seen queens and males of this species taken in coitu.

Bombus (Bombus) melanopygus Nyl.

Bombus melanopyge Nylander, Notis. Saellsk. faun. and fl. Fenn. Förh., I, 1848 (adnot.), 236, ♂.

? " *ornatus* Smith, Catal. Hym. Brit. Mus., II, 1854, p. 398, n. 52, ♀ ♂.

?* " *menestriesii* Radoszkowski, Bull. Soc. Natural. Moscou, XXXII, P. 4, 1859, p. 483, n. 6, ♀ ♂; T. 5, F. 6.

" *melanopyge* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 103, n. 31.

" *lacustris* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 103, n. 32.

" *melanopyge* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.)

Bombus lacustris Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.)
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *melanopyge* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *melampygus* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 231.
" *lacustris* Provancher, Addit. faun. Canada. Hymen., 1888, p. 340 ?, n. 9, ♀ ☿ ♂.
" *ternarius* var. *lacustris* Dalla Torre, Cat. Hym., X, p. 533, 1896 (pars.).
? " *sylvicola* Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43.
" *melanopygus* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" " H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, n. 4.
? " " Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 242.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Types.—Possibly in existence, but I am ignorant of their whereabouts.

Pile moderately long and fine; that on face, occiput and dorsum of thorax back to the scutellum of thoroughly mixed black and yellow hairs, producing a clouded effect; pleura and scutellum yellow; first segment of abdomen yellow, second and third deep ferruginous-red, fourth black and yellow, fifth and sixth black Malar space medium.

Queen. Head.—Broadly rounded trapeziform. Face and occiput with yellow and black pile mixed, sometimes one and sometimes the other predominant. Tubercle-like areas of labrum rather deeply concaved at summits, their hind (upper) borders usually broadly rounded over; shelf-like projection small and narrow, the space above it and between the tubercle-like areas deeply excavated. Malar space nearly as wide at apex as long, about one-quarter as long as the eye; clypeus coarsely punctate; flagellum of antenna about one and four-fifths times as long as scape; third antennal segment much longer than fifth, the fifth somewhat longer than the fourth.

Thorax.—Anterior part of dorsum back to scutellum heavily clouded with black and yellow pile mixed, the black being most predominant in a very indistinct and indefinite band between the bases of the wings and in a very small spot in front of each tegula; scutellum with pure yellow pile, sometimes with a few black hairs admixed. Mesopleura with yellow pile covering them to bases of legs; metapleura with yellow pile; sides of median segment sometimes with yellow, sometimes with dark pile. Disc naked and smooth.

Abdomen.—Dorsum: segment one covered with pure yellow pile; segments two and three covered with deep ferruginous-red pile; segment four sometimes entirely black and sometimes entirely yellow, but usually mostly black and with more or less yellow pile either on the sides or along the apical margin or both; segment five usually entirely black, but very often with a touch of yellow pile on the sides and sometimes with pile of the same color along the apical margin; segment six black, with rusty tip. Venter, except apical segment, usually clothed for most part with light pile. Hypopygium without median carina.

Wings.—Rather strongly stained with brown, but not dark; the fore wings lightest across the middle portion.

Legs.—Coxæ sometimes entirely dark, but usually with some light hair; trochanters always with more or less light pile, especially the hind pair, the fore pair sometimes with very little; fore and middle femora sometimes entirely dark, but usually with more or less light pile on the lower sides of their basal portions; hind femora always with a large amount of yellow hair on the lower sides of their basal halves; fore tibiæ always dark; middle tibiæ usually entirely dark, but sometimes with more or less ferruginous hair near the tips on the outer sides; corbicular fringes very often entirely black, but usually more or less strongly ferruginous with black hairs admixed.

Worker.—Much like the queen, but with wings slightly lighter and corbicular fringes usually entirely black.

Male. Head.—Face and occiput bearing yellow pile without a very strong admixture of black hairs; ventro-lateral sides of head with a considerable amount of light pile. Malar space distinctly longer than its width at apex, about one-fourth as long as the eye; clypeus covered up with pile; flagellum of antennæ about two and two-thirds times as long as the scape; third antennal segment shorter than fifth, the fourth shorter than the third.

Thorax.—Coloration much as in females; yellow on anterior part of dorsum usually more pronounced, thus making a black interalar band more definite; pleura and sides of median segment densely covered with light yellow pile.

Abdomen.—Coloration much as in females. Fourth dorsal segment sometimes entirely black, but usually mostly covered with yellow pile with only a small amount of black hair intermixed; fifth segment sometimes entirely black and sometimes entirely yellow, but usually mostly black with a touch of yellow near each side margin or along the apical margin; sixth and seventh segments entirely black. Venter clothed mostly with yellow pile.

Genitalia.—Outer spatha much like that of *B. vagans* (fig. 131), but with posterior border usually more irregular. Inner spatha like that of *B. perplexus* (fig. 145), but with only a very small fenestra. Claspers and sagittæ resembling those of *B. fernaldi* (figs. 74 and 110)

very closely. Shaft of sagitta straight or nearly so, like that of *B. vagans* (fig. 67), and with a sharp tooth-like projection on the ventro-lateral side at about the middle, as in that species and in *fernaldi*.

Wings.—About like those of the worker.

Legs.—Coxæ, trochanters and femora all with a conspicuous amount of yellow pile; anterior and middle tibiæ and corbicular fringes usually all black. Outer faces of posterior tibiæ very slightly convex and nearly naked down the middle portion; basal halves of outer faces and of hind borders of posterior metatarsi bearing long, and usually mostly dark, hairs.

Dimensions.—Length: queen, 15 mm. to 18 mm.; worker, 11 mm. to 15 mm.; male, 9 mm. to 13 mm. Spread of wings: queen, 29 mm. to 36 mm.; worker, 25 mm. to 29 mm.; male, 21 mm. to 26 mm. Width of abdomen at second segment: queens, 8 mm. to 10 mm.; worker, 6½ mm. to 8 mm.; male, 5½ mm. to 7 mm.

Redescribed from ten queens, eleven workers and fourteen males.

Habitat.—I have records of this species from Alaska (southern), Mackenzie, Athabasca, Hudson Bay country (Fullerton, one ♀), Baffin Land (one worker), British Columbia, Saskatchewan (a single record), Alberta, Vancouver Island, Washington, Oregon (Mt. Hood and Corvallis), Wyoming and Colorado. Apparently a common species throughout western Canada and in southern Alaska, but for the most part rare in Canada east of the Rocky Mountains and, in the western United States, rare (very rare in Wyoming and Colorado) and confined mostly to the mountain chains, being a strictly Boreal form. While it is apparently rather common in southern British Columbia, I have no record from Montana, though I have seen four Schmitt boxes full of bumble-bees from the western part of that state. It seems, however, as though it must be present there and, in some localities at least, in some abundance. It seems probable also that it is present in the higher lands of Idaho and northern Utah and possibly also of northern New Mexico and northern California. It appears to reach its maximum abundance in Alaska, where it seems to be the most common species. It is not improbable that *melanopygus* is the same as *menestriesii* Rad. and present in the Aleutian Islands and Siberia as Herr Handlirsch has indicated, but I have not

been able to prove that this is so as I have not seen Radoszkowski's paper. What are the northern limits of its range in North America.

The genitalia of the male of this species are very much like those of *fernaldi*, *flavifrons*, *centralis* and *bimaculatus*. The closest ally of *melanopygus* is the European species *lapponicus* Fabricius, female and male specimens of which, labelled by Schmiedeknecht, I have examined. *Lapponicus* can be readily separated from *melanopygus* by the black pleura and distinct and well defined black interalar band of its females and by the ferruginous apical abdominal segments of its males. Is *melanopygus* merely a geographical subspecies of *lapponicus*? Other very close allies of *melanopygus* are *sylvicola* Kirby and *gelidus* Cresson.

Bombus (Bombus) sylvicola Kirby.

Bombus sylvicola W. Kirby, Faun. Bor.-Amer., IV, 1837, p. 272, n. 377.
? " *ornatus* Smith, Catal. Hym. Brit. Mus., II, 1854, p. 398, n. 52, ♀ ☿ ♂ (pars.).
? " " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 104, n. 33, ♀ ☿ ♂ (pars.).
" *sylvicola* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 106, n. 37, ♀.
" " Bethune, (Reprint, W. Kirby's Faun. Bor.-Amer.), Can. Ent., X, 1878, p. 117.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).
" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Dalla Torre, Cat. Hym., X, 1896, p. 548.
" " Ashmead, Proc. Wash. Ac. Sci., Vol. IV, May, 1902, p. 127.
" " Ashmead, Hym. of Alaska, 1904, p. 133.
" " H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, n. 4.
? " *ornatus* Cockerell, Can. Ent., XXXVIII, 1906, p. 160.
" *sylvicola* Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Type.—Probably in the collection of the British Museum, but seems to have lost its identity as Col. Bingham was unable to locate it definitely.

Pile very long and rather fine. Face and occiput with yellow pile; thorax entirely clothed with yellow pile except for a broad black band between the bases of the wings; abdomen above with first segment yellow, second and third ferruginous-red, fourth and fifth yellow and sixth black. Malar space medium.

Queen. Head.—Face with a considerable amount of yellow pile above and below the bases of the antennæ; occiput with yellow pile; sides of head entirely dark. Labrum with tubercle-like areas large and not very widely separated, their summits slightly concave, smooth and shining; shelf-like projection rather small and narrow. Malar space slightly longer than its width at apex; about one-fourth as long as the eye. Clypeus rather strongly punctate. Flagellum of antennæ about twice as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile; center of disc naked; a broad black band between the bases of the wings (about one-half as wide—from front margin to rear margin—as long —from wing base to wing base); scutellum often with anterior median portion covered with an extension of the black pile of the interalar band, but sometimes entirely yellow. Mesopleura usually covered entirely with yellow pile to the bases of the legs. Metapleura usually entirely yellow.

Abdomen.—Dorsum: segment one yellow; segments two and three ferruginous-red; segment four mostly yellow, but with more or less black pile in the middle; segment five much like segment four, often with more black pile in the middle; segment six black. Venter rather variable, usually with fringes on apical margins of segments mostly of light hairs. Hypopygium without a median carina.

Wings.—Not very deeply stained with brown; the fore pair generally lightest across the median portion.

Legs.—Coxæ usually with some yellow pile; trochanters bearing a considerable amount of yellow pile on their lower sides; femora, especially the middle and hind pair, with considerable yellow pile; fore and middle tibiæ usually with no light or yellow pile; corbicular fringes usually black, but on some specimens with more or less ferruginous hairs.

Worker.—Clypeus inclined to be sparsely punctate, smooth and shining; sides of head usually black, but sometimes with a small amount of yellow pile; apical abdominal segment for most part black above, but sometimes bearing a little yellow pile; otherwise closely resembling the queen.

Male. Head.—Face with a large patch of pure light yellow pile covering the greater part of the clypeus and extending upward beyond the bases of the antennæ, but not approaching the eye margins on either side; occiput with triangular patch of yellow pile; ventro-lateral

sides of head often with more or less yellow pile, sometimes entirely dark. Malar space somewhat longer than its width at apex; about one-fourth as long as the eye. Flagellum of antennæ about three times as long as scape; third antennal segment and fifth sebequal, the fourth shorter than either.

Thorax.—Coloration much as in females for most part, but the black interalar band, as a rule, narrower and less sharply defined—nearly obliterated in many specimens; pleura always entirely yellow to bases of legs.

Abdomen.—Dorsum: segments one, two and three colored as in females; segment four entirely yellow; segment five sometimes entirely yellow, but usually with more or less black in the middle; segment six sometimes entirely black, but usually with more or less yellow pile on the sides; segment seven mostly black, but often with a few yellow or ferruginous hairs about the tip. Venter clothed with mostly yellow pile.

Genitalia.—Much like those of *B. ternarius* Say (fig. 65), but with the inner margins of the squamæ straight or slightly outcurved, not incurved.

Wings.—Very light, subhyaline.

Legs.—Coxæ, trochanters and femora bearing a considerable amount of light yellow pile; fore and middle tibiæ usually with more or less yellowish or ferruginous pile on their posterior sides; hind tibiæ with fringes long and more or less strongly light or yellow ferruginous; outer faces of hind tibiæ somewhat convex and bare, except for a sparse scattering of hair over them; hind metatarsi with rather long fringes of light ferruginous hair on the basal two-thirds of their posterior borders.

Dimensions.—Length: queen, 13 mm. to 17 mm.; worker, 9 mm. to 12 mm.; male, 10 mm. to 13 mm. Spread of wings: queen, 29 mm. to 32 mm.; male, 24 mm. to 27 mm. Width of abdomen at second segment: queen, 7 mm. to 8 mm.; male, about 6 mm.

Redescribed from a large number of specimens of each caste.

Habitat.—I have records of this species from Alaska, Yukon, Mackenzie (Great Slave Lake) and the old territory of Saskatchewan on the west and from Labrador (Nain and Rama), Ungava (Rigolet and Ungava Bay) and Hudson Bay Country (Fullerton) on the east, and it probably ranges through all the intervening country. What are its southern limits? It does not appear to be present in the United States and is a strictly Boreal form. The most northern record which I have is Point Barrow, Alaska, North Latitude

71°. I consider the record "3 workers, Montreal," given by Bowles, questionable.

This species is most closely allied to *B. melanopygus* Nylander and *B. gelidus* Cresson. The latter may possibly be only a subspecies of *sylvicola*, while the former can be readily separated from it by the difference in the coloration of the pile on the head and on the anterior part of the dorsum of the thorax. *Sylvicola* can be readily separated from *B. ternarius* and *B. huntii* by its much longer pile.

I am following Cresson in supposing that the above described species was the one described by Kirby, though Kirby's description is a rather indefinite one.

Bombus (Bombus) gelidus Cress.

Bombus gelidus Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 184, ♀.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879. p. 23. (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
? " " Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 127.
" " Viereck, Ent. News, XIV, Feb., 1903, p. 54, ♀.
? " " Ashmead, Hym. of Alaska, 1904, p. 133.

The following description is made from two queens (one of them the *type*, in the collection of the American Entomological Society), fourteen workers (the cotypes of this caste), and one male from Alaska (labelled *B. gelidus* in Prof. Cockerell's handwriting). The type male is in the collection of the American Entomological Society. Two of the cotype workers are deposited in the collection of the Massachusetts Agricultural College and the remainder in the collection of the United States National Museum.

Pile long and of medium texture. Face of the females mostly dark, of the male with a noticeable tuft of yellow pile; occiput usually with considerable yellow pile Dorsum of thorax, except a distinct, but somewhat indefinite, black interalar band, covered with rather pale yellow pile. Dorsum of abdomen with the first, fourth and often the fifth segments covered with yellow pile, the second and third segments ferruginous-red and the apical segment dark. Malar space of medium length.

Queen. Head.—Face with a small tuft of yellow hairs between and below the bases of the antennæ, or almost entirely dark; occiput with a triangular patch of pale yellow pile, with black hairs more or less

strongly admixed; cheeks dark. Labrum with tubercle-like areas having their posterior (proximal) margins rounded and their summits flat or slightly concaved; the surface between these areas and above the shelf-like projection rather deeply excavated; the shelf-like projection rather narrow and not prominent. Malar space fully as long as its width at the apex, about one-fourth as long as the eye. Clypeus coarsely, though somewhat sparsely, punctate over the disc. Third antennal segment longer than the fifth, the fifth longer than the fourth; flagellum about twice as long as the scape.

Thorax.—Anterior part of dorsum covered with rather light yellow pile; a moderately broad black band between the bases of the wings, its hind border extended backward somewhat onto the middle of the scutellum; the scutellum covered, for the most part, with rather pale yellow pile; each tegula with an indefinite line of black pile running forward from it to the anterior margin of the thorax; mesopleura largely covered with yellow pile, but their lower portions dark, the yellow not reaching the bases of the legs; metapleura mostly clothed with dark pile, but with a slight admixture of yellow hairs; sides of the median segment mostly dark, but with some light hairs.

Abdomen.—Dorsum: segment one clothed with rather pale yellow pile, sparsely so in the middle; segments two and three covered with ferruginous-red pile, but sometimes with black hair on the base and extreme sides; segment four rather pale yellow, but sometimes with some dark pile on the middle; segment five dark, but sometimes with some light hairs on the sides; segment six dark. Venter mostly dark.

Wings.—Somewhat stained with brown, but almost light enough to be called subhyaline.

Legs.—Mostly dark; the posterior femora sometimes with considerable light pile; the corbicular fringes dark; the fore and middle tibiæ on the type specimen with considerable ferruginous pile on their hind sides.

Worker.—Much like the queen, but with the face very often entirely dark and the fifth dorsal abdominal segment sometimes entirely covered with yellow pile; mesopleura usually covered with light yellow pile to the bases of the legs, but occasionally mostly dark; tegulæ usually with no line of dark hairs running forward from them; metapleura and sides of the median segment very often mostly clothed with light pile; the corbicular fringes often tinged considerably with light ferruginous; the middle femora and the middle and hind trochanters often with a sprinkling of light hairs, the hind trochanters often having a large amount of it on their lower sides.

Male. Head.—Face with a strong tuft of yellow pile running down from the bases of the antennæ and nearly covering the clypeus, the coloration otherwise being much like that of the females. Malar space

distinctly longer than its width at the apex, about one-fourth as long as the eye. Third and fifth antennal segments subequal in length, the fourth shorter than either.

Thorax.—Coloration much like that of the worker, but the dark interalar band more indefinite, there being a slight mixture of yellow hairs with the dark.

Abdomen.—Dorsum: segment one pale yellow; segments two and three rather pale ferruginous-red; segment four pale yellow, with some dark hairs admixed in the middle; segments five, six and seven dark, but with some light hairs admixed. Venter clothed mostly with dirty whitish pile.

Wings.—Subhyaline.

Legs.—Coxæ, trochanters and femora with a large amount of pale yellow pile; fore and middle tibiæ with considerable pale ferruginous pile on their hind sides; hind tibiæ with outer faces convex and mostly bare and their fringes pale ferruginous; hind metatarsi with long pale ferruginous hind fringes.

Dimensions.—Length: queen, 16 mm. to 18 mm.; worker, 8 mm. to 12 mm.; male, about 12 mm. Spread of wings: queen, about 35 mm.; worker, 20 mm. to 26 mm.; male, about 26 mm. Width of abdomen at second segment: queen, about 9 mm.; worker, $4\frac{1}{2}$ mm. to 7 mm.; male, about $6\frac{1}{2}$ mm..

Habitat.—Aleutian Islands, Popoff Island, Koyukuk River, Kukak Bay, Nualaska. Most of the specimens which I have seen were collected by Prof. Trevor Kincaid on the Harriman Alaskan Expedition. One worker before me, which seems to be a little aberrant in coloration, from Signuia, Baffin Land (Schuchert and White), appears to belong to this species.

This species is very closely allied to *sylvicola*, but the faces of all the castes have more yellow pile than does that species. The queen of *sylvicola* has the metapleura yellow and the mesopleura yellow to the bases of the legs, while the queen of *gelidus* has the metapleura mostly dark and the yellow on the mesopleura falling short of the bases of the legs. I have been unable to find any difference in structure between the two species and the differences in coloration are, after all, slight and I think it probable that they will some day be considered as mere color variants of the same species.

Bombus (Bombus) perplexus Cress.

Bombus elatus Harris, Catal. Insect, Mass., 1835, p. 70. (Catal.).
" *perplexus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 91, n. 5, ♂.
" *hudsonicus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 92, n. 7, ♂.
" *perplexus* Packard, Proc. Essex Instit., IV, 1864, p. 117, ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" " Bowles, Ann. Rep't. Ent. Soc. Ont., 1880, p. 33.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " var. *hudsonicus* Cress., Syn. Hym. No. Amer., 1887, p. 308.
" " Dalla Torre, Cat. Hym., X, 1896, p. 539.
" " var. *hudsonicus* Dalla Torre, Cat. Hym., X, 1896, p. 539.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Types.—I have been unable to locate the male and it is possibly lost. The cotype queens are scattered in the following collections: United States National Museum, American Entomological Society, Museum of Comparative Zoölogy, Colorado Agricultural College, Leland Stanford Jr. University, New Hampshire College, Montana Agricultural College, Massachusetts Agricultural College, Connecticut Agricultural Experiment Station and the private collection of Prof. T. D. A. Cockerell. The cotype workers are deposited in the following collections: Massachusetts Agricultural College, United States National Museum, American Entomological Society, New Hampshire College, Museum of Comparative Zoölogy, Montana Agricultural College and the private collection of Prof. Cockerell.

Pile rather long and fine. Females with face black, occiput yellow, dorsum of thorax yellow, lower half of pleura black, the two basal dorsal segments of the abdomen yellow and the rest black, venter black, the wings moderately brown, legs black, and malar space moderately long. Males with face, occiput, dorsum and pleura of thorax, and first three dorsal segments of abdomen yellow; the remaining dorsal segments black.

Queen. Head.—Face very often with a slight sprinkling of light pile, visible with a lens, but usually entirely black; occiput usually with a triangular patch of pure light yellow pile, but often with black

hair admixed; sides of head entirely dark brown or black. Labrum with tubercle-like areas well separated and flat or slightly concaved on their summits, the space between them being deeply excavated; shelf-like projection only moderately wide and prominent; translucent areas variable, sometimes visible to the naked eye and sometimes absent. Malar space about as long as its width at apex, about one-fourth as long as the eye; clypeus rather sparsely but coarsely punctate; flagellum of antennæ about twice as long as scape; third antennal segment longer than fifth, the fifth longer than the fourth.

Thorax.—Dorsum covered with yellow pile; center of disk naked, smooth and shining, but the naked spot usually nearly covered up by the pile bending over it on all sides; mesopleura bearing yellow pile for some distance below the bases of the wings, but the lower half always entirely dark; metapleura and sides of median segment usually entirely or mostly dark, but often with light pile only.

Abdomen.—Dorsum: segment one usually entirely yellow but often with a little black pile on the anterior face at the corners (just over the apparent anterior margin); segment two usually entirely yellow, but often with only the middle yellow and the sides more or less black; segments three, four and five usually entirely black, but the apical margin of the fifth occasionally with a fringe of light hair; apical segment mostly black, but the sides with light yellowish ferruginous hair. Venter usually entirely dark, but the apical segment and apical margin of the fifth segment often with more or less ferruginous pile. Hypopygium without a median carina.

Wings.—Only moderately stained with brown; the fore pair darkest in the median, anterior portion of submedian, basal portion of second discoidal and anterior portion of the radial cells and in the region beyond the veins.

Legs.—Black and corbicular fringes black; very rarely with some light pile on trochanters.

Worker.—Like the queen, except in size; wings somewhat lighter in color.

Male. Head.—Triangular in outline as seen from in front; face well covered with mixed black and yellow pile, sometimes the black but usually the yellow being predominant and very nearly reaching the inner margin of the eye on each side; occiput well covered with usually pure yellow pile; ventro-lateral portions of head bearing a large amount of light pile, this connecting with the yellow on the occiput. Malar space longer than its width at apex, about one-quarter as long as the eye. Clypeus usually pretty well covered up with pile, sometimes the middle of the anterior portion more or less naked. Flagellum (fig. 21) of antennæ about three times as long as scape; third and fifth antennal segments subequal in length, the fourth shorter than either.

Thorax.—Dorsum, mesopleura to bases of legs, metapleura and sides of median segment covered with yellow pile.

Abdomen.—Dorsum: segments one, two and three entirely covered up with yellow pile; segment four usually entirely black, but sometimes partly or even wholly yellow; segment five usually entirely black, but sometimes entirely yellow; segment six usually entirely black, but sometimes yellow; segment seven usually mostly dark, but always with some light pile and sometimes entirely covered with it. Venter clothed for the most part, except often the apical segments more or less dark, with light pile.

Genitalia.—Outer spatha (fig. 140) very short and broad, its anterior margin deeply and evenly incurved, side margins rather evenly rounded behind and incurved in front, posterior margin straight or incurved; apical border of ventral surface bearing short hairs all the way across and with a somewhat scattering tuft of long hairs on each side; anterior lateral projections long and rounded at the end. Inner spatha (fig. 145) with side margins strongly incurved; apex squarish with corners more or less pointed, the posterior margin usually being incurved somewhat; ventral surface of apical portion covered with short to moderately long hairs; a single, large, median fenestra present somewhat in front of the center. Claspers (figs. 69 and 76) with branches strongly pointed on the inner sides of their tips as seen from above; volsellæ much broader than those of *B. vagans;* tips of the nuces protruding prominently at the bases of the volsellæ, this being the most distinctive character exhibited by the genitalia; sagittæ as already described for the group.

Wings.—Subhyaline; much lighter than those of queens.

Legs.—Coxæ, trochanters and femora all with considerable light pile; fore and middle tibiæ usually entirely dark, but sometimes with considerable light yellowish ferruginous pile on their hind sides, especially toward the tips; outer faces of posterior tibiæ very slightly convex and nearly naked down the middle, but with a scattering of short hairs; corbiculæ rather weak, their fringes mostly black, but usually, at least the hind ones, with more or less of a dull ferruginous tinge; posterior metatarsi with hind fringes short.

Dimensions.—Length: queen, 15 mm. to 20 mm.; worker, 9 mm. to 14 mm.; male, 11 mm. to 15 mm. Spread of wings: queen, 34 mm. to 41 mm.; worker, 21 mm. to 31 mm.; male, 25 mm. to 30 mm. Width of abdomen at second segment: queen, 9 mm. to 11 mm.; worker, 5 mm. to 8 mm.; male, 5 mm. to 6½ mm.

Described from a large series of specimens of each sex.

Variations.—Besides the variations noted in the above description, the following are worthy of notice:

Color Variant 1.—Very rarely the queen has the pleura covered with

yellow pile to the bases of the legs. When this is the case, the species can still be separated from the *B. vagans* queen by means of the light pile on the sides of its apical abdominal segment as well as by its distinctly larger size and generally finer pile.

Color Variant 2.—The color characters of the males are sometimes carried over into the workers somewhat, the workers then having entirely light pleura and the third dorsal abdominal segment as well as the first two entirely covered with yellow pile.

Male Color Variant 1.—The color characters of the females are sometimes carried over into the males somewhat, the males then having the lower parts of the pleura covered with dark pile.

Habitat.—I have records of this species from the Hudson Bay Country and the provinces of Quebec, Ontario and Manitoba in Canada, from all the New England and Middle Atlantic States, except Maine, New Jersey, Delaware and Maryland, and from the extreme western part of North Carolina. Though it has never been reported from New Brunswick and Maine, it is almost certain to be present in both. It probably is not present in southern New Jersey, Delaware or eastern Maryland. In Virginia, West Virginia, North Carolina and Tennessee, it seems to be confined to the Allegheny Mountain region. If in Kentucky, it is probably confined to the Cumberland Mountains. I have records from Michigan, Wisconsin and Minnesota. It is probably also present in North Dakota. It appears to be a strictly Boreal and Transition form and, though inclined to be rather rare throughout its entire range, appears to reach its maximum abundance in the latitude of northern New England. It does not appear to range into the far north. What are its northern and western limits? The records of this species from Colorado, by Cockerell and Titus (Can. Ent., XXXIV, 1902, pp. 37, 39 and 40) are, beyond question, erroneous and were probably based on the presence of the very aberrant males of some other known species, possibly of some *Psithyrus* males.

Nests.—I have taken two nests of this species, both in Vermont, in early August, in the walls of houses. They were both made of wool material woven together, apparently the deserted homes of mice, and both were severely parasitized by *Nephopteryx edmansii* Packard. One nest contained five

queens, nine workers and one male. I have dissected the male and compared its genitalia carefully with those of many other specimens. The other nest contained eight queens and thirty-three workers. This is the gentlest and least ready to sting of all the bumble-bee species which I have had to deal with in the living condition. This seems peculiar, as *B. vagans*, which seems to be its nearest ally, is exceedingly ferocious.

The females of this species can readily be separated from those of all its nearest allies by the dark lower portion of the pleura, and the males can readily be distinguished by the general coloration already described and by the strongly protruding nuces of the genitalia. In collections, the females have long been confused with those of *vagans* and *affinis*.

Had I never taken a male in the nest, I should have said that these males and females should go together as they have the same range of habitat, are of corresponding abundance throughout that habitat, belong to the same group and are most closely related, as shown both by coloration and by structure, to the females and males respectively of the same species, and as there are no other females or males, belonging to the same group and within the same habitat, which have not been satisfactorily mated.

Cresson, in his original description of the type male, says that the third dorsal abdominal segment had "a slight admixture of black." All the males having the third segment noticeably darker (though yellow for the most part) than the first two, which I have dissected, have had *vagans* genitalia and, for this reason, I think it not impossible or even improbable that the type or *perplexus* was a male *vagans*. If this surmise is correct, then this species should take the name *hudsonicus* and the name *perplexus* should go into the synonomy of *vagans*. As I have not seen the type specimen in question, however, I will let this species stand as *perplexus* until we get more certain knowledge about the matter.

I have seen several queens in the Harris collection which had been named *Bombus elatus* F. by Harris.

Bombus (Bombus) vagans F. Sm.

Bombus vagans Smith, Cat. Hym. Brit. Mus., II, 1854, p. 399, n. 53, ♀.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 91, n. 4, ☿ ♂ (not the ♀).
" *consimilis* Cresson, Proc. Ent. Soc. Phila., III, 1864, p. 41, n. 4, ♀.
" *vagans* Packard, Proc. Essex Instit., IV, 1864, p. 115, ☿ ♂ (not the ♀).
" *consimilis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" *vagans* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
? " " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" *consimilis* Provancher, Natural. Canad., XIII, 1882, p. 266, n. 1, ♀ ☿ (not the ♂).
" " Provancher, Faun. entom. Canada. Hymen., 1883, p. 734, n. 1, ♀ ☿ (not the ♂).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307, ♀.
" *vagans* Cresson, Syn. Hym. No. Amer., 1887, p. 308, ☿ ♂.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 229, ☿ ♂ (not the ♀).
" " var. *consimilis* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 229.
" " Provancher, Addit. faun. Canada. Hymen., 1888, p. 339, n. 7, ♀ ☿ ♂.
" *consimilis* Smith, Economic Entomology, 1896, fig. 473 c., ♀.
" *vagans* Dalla Torre, Cat. Hym., X, 1896, p. 560.
" " Harvey and Knight, Psyche, VIII, 1897, p. 79.
" " var. *consimilis* Dalla Torre, Cat. Hymen., X, 1896, p. 560.
" " Titus, Can. Ent., XXXIV, 1902, pp. 37 and 44.
" *consimilis* Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, pp. 177 and 178, ♀ ♂.
" *vagans* Howard, Insect Book, 1904, Plate II, fig. 10.
" " Kellogg, American Insects, 1905, Plate XII, fig. 5.
" *consimilis* Smith, Economic Entomology, 1906, fig. 473 c., ♀.
" " Lovell, Ent. News, XVIII, May, 1907, pp. 198-199, ♀ ☿ ♂.
" *vagans* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17; 1908, p. 111.
" *consimilis* Swenk, Ent. News, XVIII, July, 1907, p. 296, n. 6.
" " Titus, Biol. Surv. Mich., Ecology of Isle Royale, Lake Superior, 1908, p. 317.
" " Cockerell, Can. Ent., XLII, 1910, p. 25.

Types.—Queen in the collection of the British Museum; worker and male in the collection of the American Entomological Society. The type of *consimilis* Cress. is also in the latter collection.

Pile of medium length and usually coarse. Face mostly dark; occiput more or less yellow; thoracic dorsum and pleura yellow; dorsum of abdomen with basal third usually yellow and apical two-thirds usually black; venter dark; corbicular fringes black; wings not very dark.

Queen. Head.—Elongate. Face mostly black, but very often with a sprinkling of yellow hairs about the bases of the antennæ; occiput sometimes with a triangular patch of pure yellow pile and sometimes with black and yellow hair mixed in varying proportions; cheeks dark, occasionally with a very little light pile on the ventro-lateral portions. Labrum with tubercle-like areas moderately separated, their summits only slightly concaved and their margins rounded; the region between these areas and above the shelf-like projection rather deeply excavated; the shelf-like projection narrow and not very prominent; translucent areas large, very plainly visible to the naked eye. Malar space longer than its width at apex, fully one-fourth as long as the eye. Clypeus very sparsely punctate over the disc. Flagellum of antenna about twice as long as the scape; the third antennal segment much longer than the fifth, the fifth longer than the fourth.

Thorax.—Center of disc naked, smooth and shining and often with a few black hairs mixed with the yellow surrounding it (most of the specimens from western Ontario, Assiniboia, Alberta and Montana have noticeably more black hair surrounding this bare area than have the eastern specimens, there even being enough in some specimens to form a somewhat indefinite dark interalar band); the remainder of the dorsum entirely covered with yellow pile; mesopleura covered with yellow pile to the bases of the legs; metapleura with yellow pile; sides of median segment with yellow pile, often with black hairs admixed.

Abdomen.—Dorsum: segments one and two entirely covered with yellow pile; the remaining segments entirely black. Venter black.

Wings.—Strongly, but not very deeply, stained with brown; the fore pair lightest across their middle portions, being hyaline or subhyaline there.

Legs.—Uusually entirely dark, but the coxæ, trochanters and femora often with touches of yellow pile.

Worker.—Much like the queen; the occiput sometimes almost entirely black; the wings somewhat lighter than those of the queen; usually with a little more black hair, mixed with the yellow surrounding the bare center of the disc of the thorax, than in the case of the queen.

Male. Head.—Face and occiput largely covered with yellow piles the former very often with black hair more or less admixed; cheek, largely covered with yellow pile, this usually connecting more or less with the yellow on the occiput. Malar space distinctly longer than its width at apex, between one-fifth and one-fourth as long as the eye. Clypeus pretty well covered up with yellow pile. Flagellum of antenna about three times as long as the scape; fifth antennal segment slightly longer than the third, the third distinctly longer than the fourth.

Thorax.—Much like those of the females.

Abdomen.—Dorsum with the first two segments entirely covered with yellow pile and with the remaining segments entirely black, except usually some yellow pile on the extreme sides of the fifth and sixth segments; venter usually with some black hairs, but mostly clothed with yellow pile.

Genitalia.—Outer spatha (fig. 131) with anterior margin broadly and somewhat deeply incurved, side margins more or less incurved; hind margin broadly rounded, central portion of ventral surface more or less reticulated, each side of the apical portion of the ventral surface with a scattering tuft of rather long hairs. Inner spatha (fig. 105) with sides of front margin straight and slanting backward, the side margins strongly incurved: the apical portion rather narrow at the end and with straight or outcurved hind margin, apical portion of ventral surface bearing rather dense hair of medium length, an elongate median fenestra present behind the center. Claspers (figs. 64 and 67) as already described for the group; volsellæ very slender; squamæ triangular in outline, but their margins somewhat outcurved. Sagittæ usually with nearly straight shafts, sometimes, however, with them bent considerably in the middle.

Wings.—Distinctly lighter than those of the queen; subhyaline.

Legs.—Coxæ, trochanters and femora all with considerable yellow pile on their lower sides; fore and middle tibiæ sometimes entirely dark, but usually with a few ferruginous hairs on the hind sides; hind tibiæ with outer faces convex and largely naked, especially on the distal half; corbicular fringes usually black, but sometimes rather strongly tinged with ferruginous, the front fringes being rather short; posterior metatarsi with rather short and more or less ferruginous hind fringes.

Dimensions.—Length: queen, 13 mm. to 17 mm.; worker, 7 mm. to 13 mm.; male, 10 mm. to 14 mm. Spread of wings: queen, 27 mm. to 35 mm.; worker, 16 mm. to 27 mm.; male, 24 mm. to 28 mm. Width of abdomen at second segment: queen, $7\frac{1}{2}$ mm. to $9\frac{1}{2}$ mm.; worker, 4 mm. to $7\frac{1}{2}$ mm.; male, $5\frac{1}{2}$ mm. to $6\frac{1}{2}$ mm.

Redescribed from numerous specimens of all castes, one of the queens being a homotype of *consimilis* Cresson.

Variation.—This species is somewhat variable, not only in color, but also in the character of the pile and the length of the malar space of the queen. The following table will show the variation in the length of the malar space, as compared with the width of the eye, of the queen, the measurements having been made with a Filar micrometer:

Specimens.	Length of malar space in micrometer spaces.	Width of eye in micrometer spaces.	Ratio between length of malar space and width of eye.
1.	6.5	8.7	.7471
2.	6.5	9.	.7222
3.	6.25	8.75	.7143
4.	6.	8.4	.7143
5.	6.4	9.	.7111
6.	6.33	9.	.7033
7.	6.75	9.6	.7031
8.	6.17	8.84	.6976
9.	6.4	9.33	.6860
10.	6.4	9.35	.6858
11.	6.5	9.5	.6842
12.	6.	9.	.6667
13.	5.94	9.	.6600
14.	6.6	9.75	.6562
15.	6.	9.4	.6489
16.	5.79	9.1	.6363
17.	4.6	7.33	.6275
18.	6.	9.6	.6250
19.	6.	9.67	.6210
20.	4.95	8.	.6171
21.	4.67	8.	.5833
22.	4.67	8.7	.5714
23.	4.67	8.2	.5691
24.	4.83	8.5	.5682
25.	4.75	8.4	.5655
26.	4.50	8.	.5625
27.	4.67	8.33	.5606
28.	4.33	7.75	.5587
29.	4.6	8.25	.5575
30.	4.67	8.4	.5559
31.	4.75	8.6	.5523
32.	4.40	8.	.5500
33.	4.83	8.83	.5470
34.	4.6	8.5	.5412
35.	4.33	8.	.5412
36.	4.8	9.	.5333
37.	4.25	8.	.5312
38.	4.4	8.5	.5176
39.	4.2	8.2	.5122
40.	4.4	8.6	.5116

It will be noticed that the variation between the two extremes is quite constant, except for a break between speci-

20 and 21, and it seems probable that the examination and measurement of a large number of specimens would completely fill up this gap. The following subspecies and color variants seem distinct enough for recognition and description:

Subspecies *vagans*.—The typical form described above; the following color variants grade completely into it:

Color Variant 1.—Queen and worker like the typical form, but with only the basal portion of the second dorsal abdominal segment covered with yellow pile. Numerous specimens from New Hampshire, Massachusetts and Ontario. I have seen specimens of this color variant taken from the same nest with specimens of the typical form.

Color Variant 2.—Queen and worker like the typical form, but with the extreme side margins of the third and fourth dorsal abdominal segments bearing yellow hair and the fifth dorsal segment entirely covered with yellow pile. Several specimens from Massachusetts and Ohio.

Male Color Variant 1.—Like the typical male, but with the third dorsal abdominal segment largely covered with yellow pile (thus approaching closely to the coloration of the *perplexus* male, but in *vagans* this third segment is always distinctly darker than the second). Several specimens from Massachusetts.

Male Color Variant 2.—Like the typical male, but with the side margins of the third and fourth dorsal abdominal segments bearing yellow hair and the fifth and sixth dorsal segments entireiy covered with yellow pile. Several specimens from New Hampshire and Massachusetts.

Subspecies *sandersoni*. Subsp. nov.—*Queen*, like the queen of subspecies *vagans*, but with pile of distinctly finer texture; malar space not longer than its width at apex, about one-fifth as long as the eye (this is the short end of the variation tabulated above). Dimensions on the average smaller than those of subspecies *vagans* queen; length, 12½ mm. to 15 mm.; spread of wings, 27 mm. to 32 mm.; width of abdomen at second segment, 7 mm. to 9 mm.

Described from seventeen queens (cotypes), deposited in the following collections: New Hampshire College of Agriculture, Massachusetts Agricultural College, American Entomological Society and United States National Museum. I take pleasure in naming this subspecies for Prof. E. D. Sanderson. I have seen specimens of it from New Hamp-

shire (Hanover and Durham) and Massachusetts (Amherst) only.

Habitat.—This species ranges through the greater part, at least, of the Transition and Upper Austral Zones east of the Rocky Mountains and runs over considerably into the Canadian Zone and is also present among the eastern ranges of the Rocky Mountains, at least in Wyoming, Montana and Canada. I have records of it from all the New England and Middle Atlantic states, from North Carolina, Kentucky, Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota (St. Paul and Lake Itasca), Iowa, Missouri, Kansas, Nebraska, the Dakotas, eastern Colorado, Wyoming and Montana (Missoula, Big Fork, Ravalli County) in the United States and from Quebec (Meach Lake), Ontario (Ottawa, Muskoka, Nepigon, Rostrevor), the old Territory of Assiniboia (Regina) and Alberta (Banff) in Canada. It is a common species throughout the greater part of its range and, in some localities, is the most abundant species of *Bombus* present. What are its northern and southern limits in the eastern and in the western parts of its habitat?

Nests.—I have taken but a single nest of this species. It was made up of dry grass woven together and was on the surface of the ground in an open field. It contained two queens, eight workers and two males and was taken in the day time of July 20, 1904. The workers of this nest were the most vicious and ready to sting of any with which I have had any experience. In the collection of the American Museum of Natural History is a nest of this species which was taken by Mr. Wm. Beutenmüller at Potato Knob in the Black Mountains of North Carolina (elevation 6,420 feet) about July 1, 1902. This nest was located in the hollow trunk of a standing mountain ash and it contained two queens and eight workers, but many bees escaped as it was taken in the day time. This nest, like the one taken by me, was apparently an adopted mouse nest, it being, as usual, of dried grass.

This species is apparently rather closely related to *B. bimaculatus*, from which it can be separated by the greater amount of yellow pile on the second dorsal abdominal segment and by the volsellæ of the genitalia of the males dis-

tinctly narrower towards their ends and with much smaller and less prominent apical projections than in *bimaculatus*. *Vagans* is very closely related to *B. cockerelli*, from which it can be separated by the greater amount of dark pile between the bases of the wings and of yellow pile on the apical dorsal segments of *cockerelli*, and to *B. bolsteri*, from which it differs much as it does from *cockerelli*.

The fact that the *vagans* queen of Cresson and the *consimilis* queen of Cresson have both seemed to demand the workers and males above described, in order to make out a full complement of castes for a species, has long kept this species in confusion. The capture of all three castes in the same nest, as above noted, satisfactorily decides this matter. There still remains some doubt, however, as to which of these queens Smith originally described. I corresponded somewhat with Col. C. T. Bingham of the British Museum about this matter, but was unable to get information which would definitely decide the question. It is evident that Smith's type is not a queen of *perplexus*, the only other possibility, as Col. Bingham wrote me that the type has the pleura covered with yellow pile to the bases of the legs. Col. Bingham further wrote, concerning Smith's type, that "the pubescence on the basal two segments of the abdomen is fluffy, the dividing line between the yellow and the dark pubescence not being more sharply defined than in your specimens No. 25" ("specimens No. 25" referred to specimens of the queen of *perplexus* which I sent him). This description of the pile on the abdomen of the type does not apply well to the *affinis* queen, as that queen has the pile on the dorsum of the abdomen short and the line between the black and the yellow sharply defined. Furthermore, the type, as shown by the original description and by Col. Bingham's letter, is decidedly smaller than the normal *affinis* queen and is of the same size as the normal *consimilis* queen. For these reasons, I prefer to consider the *consimilis* queen of Cresson, rather than the *affinis* queen, the same as the *vagans* of Smith until someone, who knows the two queens well, shall examine Smith's type and give a full and decisive report thereon.

Bombus (Bombus) cockerelli nom. nov.

Bombus prunellæ Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 391 (pars.).

" " Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45 (pars.).

? " *consimilis* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.

" *prunellæ* Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p. 89 (pars.).

" " Cockerell, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 238 (pars.).

? " *consimilis* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.

" *prunellæ* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313 (pars.).

Types.—Described from two queens (cotypes) and four workers (cotypes). One queen and two workers are deposited in each of the two following collections: Massachusetts Agricultural College and United States National Museum.

Pile of medium length and coarse. Face with some yellow hair; occiput with a triangular patch of yellow pile; thorax with yellow pile, except for an indefinite black interalar band; abdomen yellow at the base, black in the middle and yellow toward the apex; legs dark, but with considerable yellow pile on their basal portions; wings not very dark. Malar space long.

Queen. Head.—Elongate. Face with considerable yellow pile about the bases of the antennæ, with black hairs admixed; the triangular patch of yellow pile on the occiput with at most only a very slight admixture of dark hairs; cheeks dark. Labrum with tubercle-like areas well separated, their margins rounded and summits flat or slightly concaved; shelf-like projection narrow and not very prominent. Malar space longer than its width at apex, about one-fourth as long as the eye. Clypeus sparsely and delicately punctate over the disc, smooth and shining. Third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Front part of dorsum and scutellum covered with yellow pile, the middle portion with black and yellow pile mixed, forming a poorly defined black interalar band; center of disc naked, smooth and shining. Mesopleura, to the bases of the legs, metapleura and sides of median segment bearing yellow pile.

Abdomen.—Dorsum: segments one and two covered with yellow pile; segments three and four black, with yellow on the extreme side margins; segment five entirely covered with yellow pile; segment six

mostly dark, but with some yellow hair on the sides. Venter dark on each side of the middle line, but with sides of apical margins of most of the segments fringed with yellow hairs.

Wings.—Only moderately stained with brown; the fore pair somewhat the lightest across their middle portions.

Legs.—Coxæ, trochanters and bases of femora with considerable light yellow pile, at least on their lower sides; tibiæ dark.

Worker.—Much like the queen; face and occiput often almost entirely dark, with only a slight admixture of yellow hairs; the anterior part of the dorsum of the thorax and the middle of the scutellum often with an admixture of black hairs; wings lighter than those of the queen, subhyaline.

Male.—Unknown.

Dimensions.—Length: queen, about 15 mm.; worker, 9½ mm. to 12 mm. Spread of wings: queen, about 33 mm.; worker, 20 mm. to 26 mm. Width of abdomen at second segment: queen, about 8½ mm.; worker, 4½ mm. to 5½ mm.

Habitat.—I have records of this species from New Mexico only. They are as follows: Rio Ruidoso, White Mountains (from 6500 to 6800 feet altitude), the type specimens; Cloudcroft, several queens in the collection of the American Entomological Society. This species is very closely allied to *B. vagans* and thorough collecting may prove that it should be considered as only a subspecies.

Bombus (Bombus) bolsteri new species.

Types.—Described from four queens (cotypes) and five workers (cotypes), all from Newfoundland (Bay of Islands, Little River, Humber River near Deer Lake), deposited in collections as follows: Massachusetts Agricultural College (one queen and one worker), Museum of Comparative Zoölogy (one queen and one worker), American Entomological Society (one queen and one worker), United States National Museum (one queen and one worker) and the private collection of Judge P. G. Bolster, Boston, Mass. (one worker). Mr. Bolster collected the specimens and I name the species in his honor.

Pile rather long and of medium texture. Head dark; thorax yellow, with a very broad black interalar band, the anterior part of the dorsum also, in the case of the queen, with a more or less strong admixture of black hairs; dorsum of abdomen with the first two segments yellow, third and fourth black, fifth yellow and sixth black; corbicular fringes black. Malar space rather long.

Queen. Head.—Elongate. Face black, but with a very faint sprinkling of light hairs (visible with a lens) about the bases of the antennæ; occiput black, but often with a very faint sprinkling of yellow hairs (visible with a lens) in the middle; cheeks dark. Labrum with tubercle-like areas well separated, their margins rounded and summits flat or slightly concaved; the surface between them, and above the shelf-like projection, excavated; the shelf-like projection narrow and not prominent. Malar space longer than its width at the apex, about one-fourth as long as the eye. Clypeus very sparsely and delicately punctate over the disc, smooth and shining, the corners coarsely punctate. Flagellum of antenna about twice as long as the scape; the third antennal segment much longer than the fifth, the fifth very slightly longer than the fourth.

Thorax.—Front part of dorsum bearing a mixture (of varying proportions) of black and yellow pile; the region between the bases of the wings black, usually with an admixture of yellow hairs toward the sides; scutellum covered with yellow pile, but with an admixture of black hairs in front, especially in the middle; center of disc bare, smooth and shining; mesopleura covered with yellow pile to the bases of the legs; metapleura and sides of the median segment clothed with yellow pile.

Abdomen.—Dorsum: segments one and two yellow; segments three and four black; segment five yellow; segment six black. Venter mostly black.

Wings.—Only moderately stained with brown.

Legs.—The hind coxæ usually with some yellow hair on their outer sides; the trochanters and usually the very bases of the femora with more or less yellow pile on their lower sides; the femora and tibiæ mostly black.

Worker.—Much like the queen, but with somewhat lighter wings; the coxæ, trochanters and femora often entirely black; the anterior part of the dorsum of the thorax usually without an admixture of black hairs with the yellow; face often entirely black. Malar space somewhat variable, sometimes not longer than its width at the apex. Venter often with considerable yellow pile on the sides of the apical margins of the third, fourth and fifth segments.

Dimensions.—Length: queen, 14 mm. to 16 mm.; worker, 10 mm. to 13 mm. Spread of fore wings: queen, 32 mm. to 34 mm.; worker, 23 mm. to 28 mm. Width of abdomen at second segment: queen, $8\frac{1}{2}$ mm. to 9 mm.; worker, $5\frac{1}{2}$ mm. to 7 mm.

This species appears to be most closely related to *B. vagans*, from which it may be readily separated by the different coloration of the pile on the dorsum of its thorax and on its fifth dorsal abdominal segment.

Bombus (Bombus) couperi Cress.

Bombus couperi Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 185, ♀.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307.
" " Dalla Torre, Cat. Hym., X, 1896, p. 515.
" " Cockerell, Psyche, IX, 1901, p. 163.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Types.—Described from two queens from Canada; in the collection of the American Entomological Society.

Pile of medium length and rather fine. Face dark; occiput variable; thorax yellow, with a broad black interalar band; dorsum of abdomen with the two basal segments yellow, segment three black, segment four black or black and yellow, segment five yellow or ferruginous-yellow, segment six black or ferruginous-yellow; corbicular fringes mostly black. Malar space rather short.

Queen. Head.—Face dark, but with a sprinkling of yellow hairs (visible with a lens) about the bases of the antennæ; occiput sometimes entirely dark and occasionally with a triangular patch of pure yellow, but usually with a mixture of dark and yellow pile; cheeks dark. Labrum with large tubercle-like areas, their posterior (basal) margins somewhat sharply rounded and their summits rather strongly concaved and mostly impunctate; the surface, between these areas and above the shelf-like projection, rather deeply excavated; the shelf-like projection narrow and not prominent. Malar space not longer than its width at apex, about one-fifth as long as the eye. Clypeus sparsely and delicately punctate and shining over the disc, the corners being coarsely punctate. Flagellum of antennæ scarcely twice as long as the scape; third antennal segment distinctly longer than fifth; the fourth and fifth subequal in length.

Thorax.—Anterior part of dorsum and scutellum with yellow pile only; a broad black band between the bases of the wings, but often with a very strong admixture of yellow hairs on each side, close to the base of the wing; mesopleura covered with yellow pile to the bases of the legs; metapleura with yellow pile; sides of the median segment sometimes entirely dark, but usually with more or less yellow hair.

Abdomen.—Dorsum: segments one and two yellow; segment three black; segment four entirely black or with yellow pile on the apical portion; segment five covered with yellow or yellow-ferruginous pile; segment six usually entirely black, but often more or less ferruginous-yellow. Venter mostly black, but with the sides of the apical margins of segments three, four and five fringed somewhat with yellow hairs.

Wings.—Moderately stained with brown.

Legs.—Hind coxæ with some yellow hair on their outer sides; trochanters, and usually the very bases of the femora also, with yellow pile on their lower sides; femora and tibiæ mostly black, the corbicular fringes sometimes with a slight ferruginous tinge.

Worker and male unknown.

Dimensions.—Length, 13 mm. to 15 mm.; spread of wings, 30 mm. to 32 mm.; width of abdomen at second segment, 8 mm.

Redescribed from nine specimens, all from Canada (Labrador, Isle Royale in Lake Superior, mountains east of Codroy and Bay of Islands in Newfoundland, Nepigon in Ontario and Anticosti Island). It is apparently a strictly Boreal form and rather rare.

This species appears to be very closely related to *B. frigidus*, and it seems quite possible that extensive collecting will prove that it should be considered either a subspecies or color variant of that species. The two species, as far as I have been able to see specimens, may be readily separated by the difference in the color of their corbicular fringes. This species, to some extent, forms a connecting link between *frigidus* and *bolsteri*, but it has a distinctly shorter malar space than does the latter of those two species.

Bombus (Bombus) frigidus F. Sm.

|| *Bombus derhamellus* W. Kirby, Faun. Bor.-Amer., IV, 1837, p. 273, n. 380, ♀ (misidentification).

" *frigidus* Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 399, n. 54, ♀ ♂.

" *carriei* Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 170, n. 2, ♀, p. 175.

" *frigidus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 100, n. 25, ♀ ☿ (not the ♂).

" *derhamellus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 108.

" " Bethune (Reprint W. Kirby's Faun. Bor.-Amer.), Can. Ent., X, 1878, p. 118.

" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).

" *frigidus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).

" *derhamellus* Cresson, Syn. Hym. No. Amer., 1887, p. 307. (Catal.).

" *frigidus* Cresson, Syn. Hym. No. Amer., 1887, p. 307. (Catal.).

Bombus frigidus Provancher, Addit. Faun. Canada. Hymen., 1888, p. 341, n. 11, ♀ ☿ ♂.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., VI, 1891, p. 454 (pars.).
" " Dalla Torre, Cat. Hym., X, 1896, p. 521 (pars.).
" *frigidus* Cockerell, Psyche, IX, 1901, p. 163.
" *derhamellus* Cockerell, ibid.
? " *Oregonensis* Titus, Can. Ent., XXXIV, 1902, p. 39, ♀, and p. 44, ♂.
" *couperi* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 126.
? " " Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43, ♀ ♂.
" " Ashmead, Hym. of Alaska, 1904, p. 132.
? " *frigidus* Cockerell, Trans. Amer. Ent. Soc., XXXII, 1906, p. 312.
" " H. Friese, Ann. du. Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, no. 4.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 257.

Types.—The queen, taken in Latitude 65°, described as *derhamellus* by Kirby, is probably in the British Museum collection, but may have lost its identity. The male is in the same collection as is also the specimen on which Smith based his description of the queen.

Pile rather long and fine. Face of female black, of male yellow; thorax all yellow, except a broad black interalar band; abdominal dorsum yellow at base, black in middle and ferruginous or ferruginous-yellow at apex; corbicular fringes more or less ferruginous; malar space rather short.

Queen. Head.—Broadly triangular in outline. Occiput bearing yellow pile, without admixture of black hairs; face and sides behind eyes bearing little or no pile of a color other than dark brown or black. Labrum with large tubercle-like areas smooth on their somewhat concaved summits, their anterior borders somewhat sharply rounded, and with the shelf-like projection between them small as in *mixtus*. Malar space not longer than its width at apex, not more than one-fifth as long as the eye. Clypeus moderately to sparsely punctate, shining. Flagellum of antennæ scarcely twice as long as scape; third antennal segment distinctly longer than fifth, fourth and fifth subequal.

Thorax.—Dorsum covered with yellow pile except for a wide black interalar band, which is widest at the middle line of the body, its front margin curving forward slightly and its hind margin backward in the middle; with usually no sharp median V like extension of the black back onto the scutellum. Tegulæ dipping into the yellow in front so as to be from a third to half surrounded by it; center of disc naked, smooth

and shining; pleura usually entirely covered with yellow to bases of legs; sides of median segment sometimes with black, sometimes with yellow pile.

Abdomen.—Dorsum with segments one and two entirely covered with yellow pile; segment three entirely black; segment four either black on basal half or entirely concolorous with segments five and six, these being covered with yellowish-ferruginous pile of greatly varying shade. Venter very thinly clothed with pile, the predominating color often being light yellowish, especially toward the apex. Hypopygium without a median carina.

Wings.—Light, only slightly stained with brown. Fore wings darkest on median and submedian cells, on anterior portion of radial cell and beyond the end of the radial cell.

Legs.—Coxæ, trochanters and femora quite variable, sometimes bearing only dark pile, sometimes with a considerable amount of light or yellow hair. Fore and middle tibiæ usually bearing very little light pile; corbicular fringes quite strongly ferruginous, but usually with more or less black hairs intermixed. Posterior metatarsi bearing only short spines and pubescence, except for a basal posterior fringe of rather short hairs and a few hairs of about the same length on the basal portion of their outer sides.

Worker.—Much like the queen, but often with an admixture of black hairs with the yellow on the occiput; lower parts of pleura often dark brown or black; metapleura often with black hair only; sides of median segment with only black hair; coxæ, trochanters, femora and fore and middle tibiæ black; corbicular fringes often black. Wings lighter, as a rule, than those of queen. Clypeus sparsely punctate or entirely smooth.

Male. Head.—Somewhat rounded triangular in outline. Face with a very conspicuous patch of yellow pile between and below the bases of the antennæ; this patch, as a rule, not nearly reaching the inner margin of the eye on either side. Occiput usually bearing pure yellow pile; pile above bases of antennæ usually yellow and black mixed, the latter being greatly predominant; ventro-lateral portions of head usually with a considerable amount of light yellow pile. Labrum slightly concave transversely; malar space longer than its width at the apex, about one-fourth as long as the eye; clypeus mostly covered by pile; flagellum of antenna nearly three times as long as scape, rather suddenly thickened at base; third and fifth antennal segments subequal in length, fourth shorter than either.

Thorax.—Coloration of pile much as in queen.

Abdomen.—Coloration of pile much as in queen and worker, but the fourth as well as the third dorsal segment often entirely black; venter usually with very little, if any, dark hair.

Genitalia.—Outer spatha like that of *B. vagans* (fig. 131). Claspers much like those of *B. mixtus* (figs. 108 and 109).

Wings.—About as in worker.

Legs.—Coxæ, trochanters and femora usually bearing a considerable amount of light pile; fore tibiæ usually bearing little or no pile other than dark brown or black; middle tibiæ usually with considerable yellowish-ferruginous pile on apical part of outer sides; hind tibiæ with outer faces convex and more or less bare on apical part, the fringes long and more or less strongly yellowish-ferruginous; hind metatarsi with only short spines and pubescence, except for a fringe of rather long hairs on the basal three-fourths of the posterior border.

Dimensions.—Length: queen, 13 mm. to 16½ mm.; worker, 9 mm. to 12 mm.; male, 10 mm. to 12 mm. Spread of wings: queen, 30 mm. to33 mm.; worker, 21 mm. to 25 mm.; male, 24 mm. to 26 mm. Width of abdomen at second segment: queen, 7 mm. to 9 mm.; worker, 5 mm. to 6½ mm.; male, 5 mm. to 6 mm.

Redescribed from thirteen queens, fifteen workers and seventeen males.

Habitat.—I have seen specimens of this species from Alaska, Mackensie, "Hudson Bay Territory," Labrador and Newfoundland, and it seems to be quite common in these northern regions. What is its southern limit? I have seen one queen labelled "Vancouver" and another labelled "Colorado" and two workers labelled "Fremont Pass, Colorado, 11,500 to 12,000 feet." These are all the specimens of this species, purporting to come from the western United States or southern Canada, which I have seen among some five thousand specimens of bumble-bees from those regions, and this indicates that the species is extremely rare in all this southern part of its range and confined to the very crests of the mountain ranges, being a strictly Boreal form. In the east, it is not present in the United States unless it be in northern Maine, and it is not even certain that it is present in New Brunswick. Is it present in Quebec, Ontario, northern Michigan or northern Minnesota? It is not improbable that Prof. Cockerell's records of this species from "Truchas Peak, above timber line" and "top of Las Vegas Range," New Mexico are correct. It is probably present in western Montana, western Wyoming and parts of Idaho and Washington and possibly in parts of Oregon and California. My most northern records are: Eagle (Alaska); Ft. Rae (Mackensie), and Ungava Bay (Labrador).

As stated under the description of *mixtus*, *frigidus* is closely related to that species. It also has a very close ally in the European *B. rajellus* (Kirby) (= true *derhamellus* (Kirby) some variations of which it somewhat closely resembles in coloration and general appearance. It can, however, be separated from that species by structural characters. I have seen both queens and males of *rajellus*, labelled by both Schmiedeknecht and Kriechbaumer, and have noted differences between the two species as follows :

B. frigidus F. Sm.		**B. rajellus** Kirby.	
Females.	Males.	Females.	Males.
Occiput always yellow. Lower part of pleura always covered to bases of legs with light yellow pile.	Very strong yellow tuft on face. Interalar band distinct and well defined. Fore and hind fringes of posterior tibiæ very long. Posterior border of hind metatarsi with fringe of long hairs. Antennæ (on the average) fully one-fifth their own length shorter than those of *rajellus;* segments of flagellum not at all arcuate.	More or less darker in general coloration. Occiput always black. Lower part of pleura always dark.	A few yellow hairs on the face, mixed in with the black. Interalar band not well defined, the dorsum and pleura being comparatively quite dark. Hind tibiæ with front fringes short and hind ones only moderately long. Posterior border of hind metatarsi without fringe of long hairs. Flagellum of antennæ considerably longer, in comparison with the scape, than that of *frigidus*, its segments more or less strongly arcuate (fig. 17).

Bombus (Bombus) pleuralis Nyl.

? *Bombus praticola* W. Kirby, Faun. Bor.-Amer., IV, 1837, p. 274, n. 381.

" *pleuralis* Nyl., Notis. Saellsk. faun. and fl. Fenn. Forh., I, 1848 (adnot.), p. 231, n. 9.

" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 96, n. 14.

? *Bombus praticola* Cresson, Proc. Ent. Soc. Phila., II, 1863, n. 36.
? " " Bethune (Reprint, W. Kirby's Faun. Bor.-Amer.). Can. Ent., X, 1878, p. 118.
" *pleuralis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p, 230. (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Dalla Torre, Cat. Hym., X, 1896, p. 540.
? " *praticolus* Dalla Torre, Cat. Hym., X, 1896, p. 541.
" *pleuralis* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 127.
" *juxtus* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 217.
" *pleuralis* Ashmead, Hym. of Alaska, 1904, p. 133.
" *juxtus* Ashmead, Hym. of Alaska, 1904, p. 133.
" *pleuralis* Cockerell, Can. Ent., XLI, Jan., 1909, p. 37.
" " H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, no. 4.

Pile rather long and moderately coarse in texture. Face of females always mostly dark. Dorsum of thorax covered with yellow pile, except for a well defined black interalar band; mesopleura mostly yellow, but their lowest parts often dark. Abdomen with the two basal dorsal segmeuts mostly covered with yellow pile, but the queens with the middle portions of these two segments more or less dark; the remaining dorsal segments usually mostly or entirely black, but the third and fourth sometimes more or less ferruginous. Wings rather light. Corbicular fringes of females dark Malar space rather long.

Queen. Head.—Somewhat elongate trapeziform. Face mostly dark, but with more or less yellow pile between the bases of the antennæ; occiput sometimes entirely dark, but usually with black and yellow hair mixed, the yellow often being predominant; cheeks dark. Labrum with tubercle-like areas having their margins rounded and summits flat or somewhat concaved; shelf-like projection moderately broad and prominent. Malar space somewhat longer than its width at the apex, fully one-fourth as long as the eye. Clypeus rather delicately and sparsely punctate over the disc, the corners coarsely punctate. Third antennal segment nearly as long as the fourth and fifth taken together, the fifth longer than the fourth.

Thorax.—Dorsum, except for a broad and fairly well defined black interalar band, entirely covered with yellow pile; center of the disc naked, smooth and shining; mesopleura mostly covered with yellow pile, but the yellow only occasionally reaching the bases of the legs, the lowest portions usually being dark; metapleura mostly dark, but with some light pile on their upper portions; sides of median segment usually entirely dark, sometimes with a slight admixture of yellow hairs.

Abdomen.—Dorsum: segment one dark in the middle and yellow on the extreme sides; segment two with a black median triangle, its base

on the basal margin of the segment and its apex on the apical margin, the remainder of the segment bearing yellow pile ; segment three black, but sometimes with the apical margin, and often with the extreme side margins, fringed somewhat with yellow hairs ; segments four, five and six entirely black. Venter with the apical margins of the segments fringed more or less with yellowish hairs, especially on the sides. Hypopygium with a distinct median carina on its apical portion.

Wings —Not very deeply stained with brown ; the fore pair with the veins noticeably darker than the membranes.

Legs.—Mostly dark. The middle and hind trochanters sometimes with considerable light pile on their lower sides.

Worker.—Much like the queen, but usually with considerably lighter, subhyaline wings ; head very often entirely dark ; mesopleura usually entirely covered with yellow pile to the bases of the legs ; metapleura often mostly clothed with yellow pile ; abdomen with dorsal segments one and two usually having little or no dark pile in the middle.

Male. Head.—Triangular. Face with some yellow pile mixed with the black above the bases of the antennæ, below the bases of the antennæ heavily clothed, for the most part, with pure yellow pile ; occiput with a triangular patch of pure yellow pile ; ventro-lateral parts bearing a considerable amount of yellow hair. Malar space distinctly longer than its width at the apex, about one-third as long as the eye. Clypeus mostly covered up with yellow pile. Third antennal segment somewhat longer than the fifth, the fourth much shorter than either.

Thorx.—Clothed with yellow pile, except for a rather narrow black interalar band, the black pile from this band extending back considerably onto the middle of the anterior portion of the scutellum.

Abdomen.—Dorsum : segment one entirely covered with yellow pile ; segment two clothed with yellow, but with a slight admixture of black hairs in the middle ; segment three black ; segment four mostly black, but with a strong admixture of ferruginous hairs ; segments five, six and seven entirely dark. Venter clothed, for the most part, with yellow hair.

Wings —About like those of the worker.

Legs.—Coxæ, trochanters and femora all with a large amount of yellow pile ; fore and middle tibiæ with considerable ferruginous hair on their hind sides, especially toward their tips ; outer faces of hind tibiæ somewhat convex, the fringes long and mostly light ferruginous ; posterior metatarsi with moderately long ferruginous hind fringes.

Dimensions.—Length : queen, 13 mm. to 16 mm. ; worker, 9 mm. to 11 mm. ; male, 13 mm. Spread of wings : queen, 32 mm. to 34 mm. ; worker, 19 mm. to 22 mm. ; male, 27 mm. Width of abdomen at second segment : queen, 8½ mm. to 9 mm. ; worker, 4½ mm. to 5 mm. ; male, 6½ mm.

Redescribed from eight queens, many workers and one male.

Variation.—The male is probably usually entirely dark dorsally beyond the second abdominal segment. The malar space of the female is quite variable in length, as shown by the table of measurements given below. In this table, comparison is made with the width of the eye, the measurements having been made with a Filar micrometer.

Specimen.	Length of malar space in micrometer spaces.	Width of eye in micrometer spaces.	Ratio between length of malar space and width of eye.
1.	5.75	8.33	.6903
2.	6.	8.5	.7059
3.	4.87	6.	.7777
4.	4.67	5.75	.8118

I have seen gradations between the typical females described above and the following:

Color Variant.—Queen and worker like the typical form, but with the third and fourth dorsal abdominal segments partly or entirely covered with ferruginous-red pile, thus closely approaching *B. flavifrons* in coloration. This color variant can always be readily separated from *flavifrons* by means of its dark face and very broad and definite black interalar band. In the queen of this color variant, the dark triangle on the middle of the second dorsal abdominal segment is sometimes nearly obliterated by yellow pile.

Habitat.—The type specimens of this species were from Sitka. All the specimens, which I have seen, were from Alaska (Popoff Island, Kukak Bay, Nushagak River and Kadiak—collected by Prof. Kincaid on the Harriman Alaskan Expedition) where this species seems to be quite common. Ashmead states that it is "also found in Siberia."

B. flavifrons and *B. centralis* are apparently the closest allies of *pleuralis.*

The pile, which, in the above description, I have called yellow, is very light, approaching straw or hemp in color, and with not a very strong tinge of yellow in most specimens.

Bombus (Bombus) flavifrons Cress.

? *Bombus praticola* W. Kirby, Faun. Bor.-Amer., IV, 1837, p. 274, n. 381, ♀.
" *flavifrons* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 105, n. 35, ♀ ☿ ♂.
? " *praticola* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 106, n. 36, ♀.
" *flavifrons* Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210—also Putnam, on p. 195.
? " *praticola* Bethune (Reprint, W. Kirby's Faun. Bor.-Amer.), Can. Ent., X, 1878, p. 118.
" *flavifrons* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).
" " Bowles, Rep't Ent. Soc. Ont., 1880, p. 33.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307.
" *praticola* Provancher, Addit. Faun. Canada. Hymen., 1888, p. 341, n. 10, ♂ (not the ☿).
" *flavifrons* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 231 (pars.).
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., VI, 1891, p. 453 (pars.).
" *flavifrons* Dalla Torre, Cat. Hym., X, 1896, p. 520 (pars.).
? " *praticolus* Dalla Torre, Cat. Hym., X, 1896, p. 541.
" *flavifrons* Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43, ♀ ☿ ♂.
" *alaskensis* Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 128.
" *dimidiatus* Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 129 (not Harris, Catal. Insects Mass., 1835, p. 70).
" *flavifrons* var. *veganus* Cockerell, Amer. Nat., XXXVII, 1903, p. 891.
" *alaskensis* Ashmead, Hym. of Alaska, 1904, p. 134.
" *dimidiatus* Ashmead, Hym. of Alaska, 1904, p. 135.
? " *praticola* H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, Tome IX, no. 4.
" *flavifrons* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 312.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" *praticolus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111 (pars.).
" *flavifrons-dimidiatus* Cockerell, Can. Ent., XLII, 1910, p. 25.

Types.—At least a part of Cresson's type specimens are in the collection of the American Entomological Society. Ashmead's type specimens of *alaskensis* and *dimidiatus* are in the collection of the United States National Museum. I have carefully examined and compared these specimens.

Pile of medium length and rather coarse in texture. Face and occiput with considerable yellow pile; dorsum of thorax largely covered with a mixture of yellow and dark pile; mesopleura yellow to the bases of the legs; dorsum of abdomen with the two basal segments yellow, third and fourth segments variable and two apical segments dark; bases of legs with considerable light pile; wings subhyaline. Malar space long.

Queen. Head.—Elongate trapeziform. Face with a large patch of generally pure light, often whitish, yellow pile reaching some distance above and below the bases of the antennæ, sometimes with an admixture of dark hairs; occiput sometimes with a triangular patch of pure light yellow pile, but usually with an admixture of dark hairs; ventrolateral parts sometimes with a small amount of light pile, often connecting with the light patch on the occiput. Labrum with tubercle-like areas moderately separated, their margins rounded and summits flat or somewhat concaved; shelf-like projection not very prominent. Malar space longer than its width at apex, fully one-fourth as long as the eye. Clypeus rather finely and sparsely punctate over the disc. Flagellum of antenna about twice as long as the scape; third antennal segment much longer than the fifth, the fifth longer than the fourth.

Thorax.—The greater part of the dorsum covered with a mixture of black and yellow (of greatly varying shade) pile and thus having a distinctly clouded appearance, being darkest between the bases of the wings; the center of the disc naked; mesopleura covered with yellow pile to the bases of the legs; metapleura sometimes largely clothed with dark pile, but usually bearing light pile for the most part; sides of the median segment often entirely dark, but usually bearing a mixture of dark and light hairs.

Abdomen.—Dorsum: segment one with dark pile in the middle and yellow on the sides, or nearly or entirely clothed with yellow pile; segment two entirely covered with yellow pile, or with a more or less definite triangular median patch of dark pile, the base of this triangle being on the basal margin of the segment and its apex on or near the the apical margin; segments three and four entirely covered with ferruginous-red pile; segment five dark, but the apical margin often fringed with light hairs; segment six dark, but sometimes with some light hair on the sides. Venter with the apical margins of the segments fringed, for the most part, with yellow hairs. Hypopygium with a median carina on its apical portion.

Wings.—Subhyaline, only slightly stained with brown; the fore pair lightest across their middle portions.

Legs.—Coxæ sometimes entirely dark, but usually with some light pile; trochanters and femora with considerable light pile; fore and middle tibiæ dark, often with a few ferruginous hairs; corbicular fringes sometimes entirely dark, but usually with more or less ferruginous hairs.

Worker.—Much like the queen, but the amount of yellow pile on the face usually less, this sometimes being reduced to a mere tuft between the bases of the antennæ; occiput usually with dark and yellow pile mixed, but occasionally entirely dark; the femora often with very little light pile.

Male. Head.—Face largely covered with a dense patch of pure yellow pile; occiput largely covered with yellow pile; cheeks bearing a large amount of yellow hair, this connected with the yellow on the occiput. Malar space much longer than its width at apex, fully one-third as long as the eye. Clypeus mostly covered up with yellow pile. Flagellum of antenna about three times as long as the scape; the third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Clothed mostly with yellow pile, but the dorsum with black and yellow pile mixed between the wings.

Abdomen.—Dorsum: segments one and two entirely covered with yellow pile; segments three and four clothed with ferruginous pile; segments five, six and seven dark, but sometimes with a slight admixture of light hairs. Venter clothed mostly with light pile.

Genitalia.—Very much like those of *centralis*.

Wings.—Somewhat lighter than those of the queen.

Legs.—Coxæ, trochanters and femora all with a large amount of light yellow pile; fore and middle tibiæ with considerable light or ferruginous pile; hind tibiæ with outer faces slightly convex and naked, the fringes mostly yellow; hind metatarsi with posterior fringes light yellow or ferruginous.

Dimensions.—Length: queen, 13 mm. to 16 mm.; worker, 9 mm. to 12 mm.; male, 11 mm. to 12 mm. Spread of wings: queen, 27 mm. to 34 mm.; worker, 19 mm. to 27 mm.; male, 25 mm. to 26 mm. Width of abdomen at second segment: queen, 7 mm. to 9 mm.; worker, 4½ mm. to 7 mm.; male, 5 mm. to 6 mm.

Redescribed from many queens (one a homotype) and workers and two males.

Variation.—I have seen specimens which show a complete gradation of the typical form, above described, into the following color variants:

Color Variant 1.—(*B. dimidiatus* Ashm., pars.). Queen and worker like the typical females, but with the extreme sides of the third dorsal abdominal segment bearing black pile and with a considerable portion of the fourth dorsal segment largely clothed with dark pile. Four specimens from Fox Point, Alaska, and six workers and one male from British Columbia (Metlakatla).

Color Variant 2.—(*B. dimidiatus* Ashm., pars.). Queen and worker like the typical females, but with all the dorsal abdominal segments beyond the second entirely dark. One queen from Blue Mountains, Washington, one worker from Fox Point, Alaska, and one worker and

two males from Metlakatla, British Columbia. Prof. Cockerell also records three females of this form from Calgary, Alberta.

Color Variant 3.—Queen and worker like the typical females, but with a small amount of ferruginous pile on the middle of the second dorsal abdominal segment. Several specimens from British Columbia and Montana.

Habitat.—I have records of this species from Alaska (Eagle, Sitka, Fox Point, Metlakatla, Fort Yukon, Juneau), British Columbia (including Vancouver), Alberta (St. Albert and Calgary), Washington, Idaho, Montana, Utah, Colorado and New Mexico (Beulah). It is probably also present in parts of Oregon, Wyoming, California and Nevada. It is mainly a Boreal form, but it probably runs over into the Transition Zone considerably. It seems to be a common species throughout a considerable portion of its habitat. What are its northern and southern limits and its eastern limits in Canada? Cresson states that some of the type specimens came from Hudson Bay Territory and Kansas. I consider that at least the latter record is erroneous. I also think that the record "one male, three workers, Montreal," given by Bowles, is questionable.

This species is very closely allied to both *B. pleuralis* and *B. centralis*. It may be easily distinguished from both by means of the different coloration of the dorsum of its thorax and from *centralis* by the somewhat longer malar space of its females. It seems not impossible that extensive collecting may show that *flavifrons* and *pleuralis* should really be considered subspecies of the same species. I have been unable to decide whether the original description of *B. praticolus* referred to this species or to the color variant of *pleuralis*. Col. Bingham was unable to definitely locate the type of *praticolus*, in the collection of the British Museum, for me. It is probably in that collection, however, though it may have lost its identity.

Bombus (Bombus) centralis Cress.

Bombus centralis Cresson, Proc. Ent. Soc. Phila., III, 1864, p. 41, n. 5.
" *juxtus* Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 187.
" *centralis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).

Bombus juxtus Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).
" *centralis* Cresson, Syn. Hym. No. Amer., 1887, p. 307.
" *juxtus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *flavifrons* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 231 (pars.).
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., VI, 1891, p. 453 (pars.).
" " Dalla Torre, Cat. Hym., X, 1896, p. 520 (pars.).
" *juxtus* Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
" *monardæ* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 387.
" *juxtus* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 390.
" " Cockerell, Psyche, IX, 1901, p. 163, ♀ ♂.
" " Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43, ♀ ☿ ♂
" *centralis* Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317.
" *juxtus* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" *monardæ* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *juxtus* Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p. 89.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *centralis* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *monardæ* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *juxtus* Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, p. 453, n. 110.
" " Swenk, Ent. News, XVIII, July, 1907, p. 297, n. 8.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" *praticolus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111 (pars.).
" *juxtus* Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Type.—In the collection of the American Entomological Society, from Fort Crook, California. The type specimens of *juxtus* are also in that collection. There are cotypes of *monardæ*, which I have examined, in the collection of the American Entomological Society and in Prof. T. D. A. Cockerell's private collection. *B. monardæ* is evidently *centralis* with the ferruginous-red pile on dorsal abdominal segments three and four faded out, as some of the *monardæ* cotypes

have slight ferruginous tinges on those segments. It should be here noted that a similar fading out of ferruginous pile often occurs, in a number of other species, notably in *huntii* and *ternarius*.

Pile of medium length and texture. Face and occiput largely yellow. Thorax mostly yellow, but with a distinct black band between the bases of the wings. Dorsum of abdomen usually mostly yellow on the two basal segments, ferruginous-red on the third and fourth segments and dark on the apical segments. Venter with apical margins of segments largely fringed with yellow hairs. Wings not very dark. Bases of legs with considerable light pile. Malar space medium.

Queen. Head.—Face with a large patch of generally pure yellow pile reaching some distance above and below the bases of the antennæ. Occiput with a large triangular patch of yellow pile, often connecting with some yellow hair on the cheeks. Labrum with tubercle-like areas fairly well separated, the region between them and above the shelf-like projection being deeply excavated, their margins rounded and summits flat or concaved; the shelf-like projection moderately broad and prominent. Malar space somewhat longer than its width at the apex, between one-fifth and one-fourth as long as the eye. Clypeus finely and somewhat sparsely punctate over the disc. Flagellum of antenna about twice as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Dorsum entirely covered with yellow pile, except for a well defined black interalar band; center of the disc naked; mesopleura usually entirely covered with yellow pile to the bases of the legs, but occasionally with their very lowest parts dark; metapleura and sides of median segment usually clothed mostly, or entirely, with yellow pile, but occasionally entirely dark.

Abdomen.—Dorsum: segment one entirely yellow, or black in the middle with large tufts of yellow on the extreme sides; segment two entirely yellow, or with more or less definite median triangular patch of black or more or less ferruginous pile, the base of the triangle being on the base of the segment and its apex toward or on the apical margin of the segment; segments three and four mostly covered with ferruginous-red pile, but the extreme side margins bearing yellow pile; segments five and six black. Venter with the apical margins of most of the segments strongly fringed with yellow hairs. Hypopygium with a median carina on its apical portion.

Wings.—Somewhat stained with brown, but not strongly so; the fore pair lightest across their middle portions.

Legs.—Coxæ entirely dark or with some light pile; trochanters almost always with considerable light pile on their lower sides; femora occasionally entirely dark, but usually with a large amount of light

pile; fore and middle tibiæ dark, but often with a little ferruginous pile on their hind sides near their tips; corbicular fringes black or more or less strongly ferruginous.

Worker.—Much like the queen, but the yellow pile on the occiput often with black hairs strongly admixed; metapleura and sides of median segment always clothed with yellow pile; the two basal dorsal abdominal segments entirely covered with yellow pile.

Male. Head.—Face densely covered with a patch of pure yellow pile; occiput with a large triangular patch of yellow pile, connected on each side with the large amount of similar pile sometimes nearly covering the cheek. Malar space distinctly longer than its width at the apex, about one-fourth as long as the eye. Clypeus mostly covered up with yellow pile. Flagellum of antenna about three times as long as the scape; third antennal segment somewhat longer than the fifth, the fifth distinctly longer than the fourth.

Thorax.—Clothed with yellow pile, except for a narrow and usually poorly defined black interalar band; this band sometimes almost entirely obliterated by yellow hairs.

Abdomen.—Dorsum: segments one and two entirely yellow; segments three and four covered with ferruginous pile; segment five occasionally entirely black, but usually largely, and sometimes entirely, covered with ferruginous pile; segments six and seven dark, but very often with some ferruginous hair admixed. Venter mostly clothed with yellow pile.

Genitalia.—Outer spatha much like that of *B. vagans* (fig. 131). Inner spatha much like that of *vagans* (fig. 105), but the hind margin of the apical portion protruding strongly in the middle so as to make the apex appear weakly trilobate. Claspers and sagittæ about like those of *melanopygus*, *bimaculatus* and *fernaldi* (figs. 74 and 110), but the tips of the volsellæ narrower and their apical projections less prominent.

Wings.—Subhyaline, the fore pair darkest in the region beyond the veins.

Legs.—Coxæ, trochanters and femora all with much yellow pile; fore and middle tibiæ sometimes entirely dark, but usually with more or less light or ferruginous pile on their hind sides; hind tibiæ with outer faces convex and almost or entirely naked, the fringes dark, yellow, or somewhat ferruginous; hind metatarsi usually with moderately long and ferruginous posterior fringes.

Dimensions.—Length: queen, 12½ mm. to 16 mm.; worker, 9½ mm. to 12½ mm.; male, 10 mm. to 13 mm. Spread of wings: queen, 29 mm. to 33 mm.; worker, 23 mm. to 28 mm.; male, 22 mm. to 29 mm. Width of abdomen at second segment: queen, 7 mm. to 9 mm.; worker, 4½ mm. to 6½ mm.; male, 4½ mm. to 5½ mm.

Redescribed from many specimens (one a homotype of *juxtus* Cress.).

Variation.—The principal variation of this species has already been noted in the above description, viz., the variation in the coloration of the pile on the first and second dorsal abdominal segments. The type specimen of *centralis* represents the extreme dark variation in the coloration of these segments, and it has so much dark pile on the middle of these segments that I consider it something of an aberration. Cresson's *juxtus* represents the extreme yellow variation in the coloration of these variable segments. I cannot believe that Cresson's *centralis* and *juxtus* represent two distinct species as I find them grading completely into each other. I do not even consider them distinct subspecies. They might have properly been described as color variants of the same species, but I have seen fit to include the whole line of variation in the main description of the species.

Habitat.—I have records of this species from British Columbia, Washington, Idaho, western Montana, Oregon, Wyoming, California, Nevada, Utah, Colorado, Arizona, New Mexico (Cloudcroft, Magdalena Mountains, Beulah, Monument Rock, top of range below Sapello and Pecos rivers) and western Nebraska. Is it present in western Kansas, western Oklahoma, northwestern Texas, eastern Montana, the western Dakotas and Assiniboia? It is mainly a Transition species, but it runs over somewhat into the Boreal Region on the one side and the upper Austral Zone on the other. It is a common species throughout a considerable portion of its habitat. What are its northern and southern limits? Does it range into Mexico? The record, given by Titus (*vide* supra), of a male of this species from Woods Hole, Mass., is absolutely erroneous.

This species is most closely allied to *B. flavifrons* Cress., from which it can be separated by the somewhat shorter malar space of its females and by the more distinct and definite black interalar band of both sexes. It also resembles the color variant of *pleuralis* quite closely, but its face is largely covered with yellow pile and its black interalar band is noticeably narrower than that of *pleuralis*, at least in the females.

Bombus (Bombus) ambiguus Franklin.

Bombus ambiguus Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 159, ♀ ☿.

Types.—Described from one queen (the type), deposited in the collection of Leland Stanford Jr. University, and six workers (cotypes), distributed evenly in the collections of the American Entomological Society, the Massachusetts Agricultural College and Leland Stanford Jr. University.

Pile of medium length and rather coarse in texture. Face and occiput with considerable yellow pile; dorsum of thorax with mixed black and yellow pile in front and mostly dark between the bases of the wings and on the scutellum; mesopleura yellow; dorsum of abdomen yellow at base, black in the middle and black or slightly ferruginous at apex; wings rather strongly stained with brown. Malar space long.

Queen. Head.—Face and occiput with large patches of pure yellow pile; cheeks mostly dark, but with a little yellow hair on the ventro-lateral portions. Labrum with tubercle-like areas large and not greatly separated, their margins rounded and summits only moderately concaved, almost flat; the shelf-like projection narrow and not very prominent. Malar space distinctly longer than its width at apex, fully one-fourth as long as the eye. Clypeus sparsely and delicately punctate over the disc, almost smooth, the corners coarsely punctate. Third antennal segment much longer than the fifth, the fifth longer than the fourth.

Thorax.—Anterior part of dorsum covered with a mixture of black and yellow pile, the region between the bases of the wings entirely black and the scutellum mostly black, but with a slight sprinkling of yellow hairs on its hind margin; center of disc naked, smooth and shining; a line of dark pile running forward from the tegula on each side; mesopleura entirely covered with yellow pile to the bases of the legs; metapleura mostly yellow, but partly dark; sides of median segment dark.

Abdomen.—Dorsum: segment one well covered with yellow pile on the sides, but rather sparsely clothed and with a few dark hairs in the middle; segment two for the most part well covered with yellow pile, but less densely clothed and with a few black hairs on the basal middle; segments three and four entirely black; segment five black at base, but with light ferruginous pile on the apical portion, especially in the middle; segment six mostly ferruginous, but with some black hairs on the sides. Venter with the apical margins of all the segments, except the basal and apical one, well fringed with light yellow hair.

Wings.—Somewhat strongly stained with brown, the fore pair much the lightest across their middle portions.

Legs.—Trochanters with considerable light pile on their lower sides and the corbicular fringes with some ferruginous hairs (as seen with a lens); otherwise mostly dark; the tarsi rather strongly ferruginous.

Worker.—Much like the queen, but the occiput always and the face sometimes with a strong admixture of black hairs with the yellow; the thorax usually with a somewhat stronger sprinkling of yellow hairs on the hind margin of the scutellum than in the case of the queen; sometimes with no line of dark pile running forward from the tegula; metapleura sometimes mostly dark and sometimes mostly yellow; sides of median segment usually with a sprinkling of yellow hairs; first dorsal abdominal segment yellow on the sides, but dark and sparsely clothed in the middle; second dorsal segment sometimes as in queen, but usually with a noticeable median triangle of black pile, the base of the triangle being on the front margin and its apex reaching backward across the hind margin; the dorsum of the abdomen as a whole usually with but little light pile and sometimes entirely dark beyond the second segment; corbicular fringes usually entirely dark; trochanters sometimes with very little light pile; venter sometimes with very little light hair on the apical margins of any of the segments.

Male.—Unknown.

Dimensions.—Length: queen, 12 mm.; worker, 9 mm. to 12 mm. Spread of wings: queen, 30 mm.; worker, 21 mm. to 25 mm. Width of abdomen at second segment: queen, 8 mm.; worker, 5 mm. to 6 mm.

Habitat.—My records for this species are only those of the type specimens, as follows: California (one queen without locality label, three workers from Sisson and one worker from Santa Cruz Mountains) and Washington (two workers from Keyport). It appears to be a rare species, confined to the Pacific coast region of the western United States. What are its northern, eastern and southern limits?

This form is most closely related to *B. sitkensis* Nyl. of which it may be only a subspecies, though all the specimens before me have noticeably shorter pile than has that species.

Bombus (Bombus) sitkensis Nyl.

Bombus sitkensis Nyl., Notis. Saellsk. Faun. and Fl. Fenn. Forh., I, 1848 (adnot.), p. 235, n. 19, ♀ ♂.

" " Cresson, Proc. Ent. Soc. Phila. II, 1863, p. 102, n. 29, ♀ ☿.

" *oregonensis* Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 185, ♂.

" *sitkensis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).

Bombus oregonensis Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
? " *sitkensis* Dalla Torre, Ber. naturw.-mediz. Ver. Innsbr., XII, 1882, p. 23, n. 19, ♂.
" *oregonensis* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *sitkensis* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 232.
" *oregonensis* Dalla Torre, Cat. Hym., X, 1896, p. 538.
" *sitkensis* Dalla Torre, Cat. Hym., X, 1896, p. 549.
" *mixtuosus* Ashmead, Proc. Wash. Ac. Sci., IV, May 29, 1902, p. 128, ♀ ☿.
" " Ashmead, Hym. of Alaska, 1904, p. 134, ♀ ☿.
? " " Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
? " *oregonensis* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *sitkensis* H. Friese, Ann. du Mus. Zoöl. de l'Acad. Imp. des Sci. de St. Pétersb., 1904, tome IX, no. 4.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Types.—Nylander's specimens are probably lost. The type of *oregonensis* Cress. is in the collection of the American Entomological Society. The type specimens of *mixtuosus* Ashmead are in the collection of the United States National Museum.

Pile rather long and fine. Females with face, occiput and dorsum of thorax bearing mixed black and yellow pile, the scutellum being darker than the anterior part of the dorsum; mesopleura pale yellow; abdomen with dorsum yellow at base, dark in the middle and more or less whitish-ferruginous at the apex; corbicular fringes ferruginous; wings light; malar space medium. Males much like the females, but with pile of head and thorax mostly pure yellow. A dull looking species.

Queen. Head.—Face often with a patch of pure yellow pile (sometimes whitish and sometimes ferruginous), but usually with more or less dark hair admixed. Occiput always with dark and light pile mixed. Cheeks mostly dark, but the ventro-lateral portions often with some light hair. Labrum with tubercle-like areas large and not very widely separated, their margins rounded and summits only slightly concaved; the region between these areas and above the shelf-like projection rather deeply excavated; the shelf-like projection rather narrow and not prominent. Malar space somewhat longer than its width at apex, about one-fourth as long as the eye. Clypeus with disc rather sparsely and delicately punctate, the corners coarsely punctate. Flagellum of

antenna about twice as long as the scape; third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Dorsum covered with a mixture of dark and light pile, the light predominating on the front part and the dark predominating between the bases of the wings and on the scutellum (the center of the disc often bearing a noticeable amount of ferruginous pile); the very center of the disc naked, smooth and shining. Mesopleura sometimes entirely covered with light yellow pile to the bases of the legs, but usually with their lower parts more or less dark. Metapleura dark, but usually with some yellow pile at their upper ends. Sides of median segment with little or no light pile.

Abdomen.—Dorsum: segment one clothed for the most part with yellow pile, the very middle rather sparsely clothed and sometimes with a few dark hairs; segment two clothed entirely with yellow pile, except for a few black hairs usually present in the middle, especially at the base; segment three often entirely black, but often with a more or less noticeable apical fringe of yellow hairs; segment four sometimes entirely black, but usually with more or less whitish-ferruginous hair on its apical portion; segment five entirely clothed with whitish-ferruginous pile, sometimes with some black hair on the basal portion; segment six bearing mostly whitish-ferruginous pile, but sometimes with some short black hair in the middle. Venter mostly black toward the base, but the apical margins of most of the segments usually fringed more or less with light hair.

Wings.—Only slightly stained with brown; the fore pair usually somewhat the lightest across their middle portions.

Legs.—Coxæ and trochanters always with more or less light pile; femora sometimes entirely dark and sometimes with considerable light pile on the lower sides of their basal portions; anterior tibiæ mostly dark, but sometimes with a few ferruginous hairs; middle tibiæ sometimes entirely dark, but usually with considerable ferruginous hair on their outer sides; corbicular fringes occasionally only slightly ferruginous, but usually very strongly so.

Worker.—Much like the queen, but the face usually with the dark pile strongly predominant, the light pile being distinctly noticeable only with a lens; the corbicular fringes usually mostly or entirely dark; the fifth dorsal abdominal segment often partly and sometimes entirely dark; venter usually mostly dark; coxæ and trochanters sometimes entirely dark; fore and middle tibiæ very often entirely dark, usually with but very little ferruginous pile.

Male. Head.—Rather elongate triangular. Face, occiput and the cheeks usually with pure yellow pile, but often with a slight admixture of black hairs. Malar space much longer than its width at apex, fully one-fourth as long as the eye. Clypeus pretty well covered up with yellow pile. Flagellum of antennæ about three times as long as

the scape; the third antennal segment and the fifth subequal in length, the fourth shorter than either.

Thorax.—Sometimes bearing only yellow pile; the region between the wings and the scutellum usually more or less dark, often being as dark as in the females; the scutellum sometimes entirely yellow, with the interalar region at the same time dark; anterior part of dorsum and the pleura almost always entirely covered with pure yellow pile, but the metapleura sometimes dark; sides of median segment usually yellow, but sometimes dark.

Abdomen.—Dorsum: segments one and two with yellow pile; segment three often almost entirely yellow, but as often with only an apical fringe of yellow hairs; segment four often entirely black, but usually with some yellow pile, especially along the apical margin; segment five sometimes entirely black and sometimes with the basal portion black and the apex light ferruginous; segments six and seven occasionally entirely black or black with a few yellow hairs admixed, but usually light ferruginous. Venter, for the most part, rather heavily clothed with pale yellow pile, occasionally mostly dark as in the females.

Genitalia.—Outer spatha (fig. 125) rather short and wide; the anterior margin deeply incurved; the lateral margins nearly straight and converging rapidly posteriorly; the posterior margin somewhat variable, but usually nearly straight; the anterior lateral projections rounded at the end; the ventral surface bearing a scattering of moderately long hairs towards the hind margin. Inner spatha (fig. 144) with the sides of the anterior margin bent backward slightly; the side margins strongly incurved; the posterior margin nearly straight, the apical portion being quadrangular; a small central fenestra usually present; the ventral surface of the apical portion bearing long hairs (especially on the sides) and with these hairs rather thickly placed. Claspers like those of *B. mixtus* Cress. (figs. 108 and 109).

Wings.—Somewhat lighter than those of the queen; subhyaline.

Legs.—Coxæ, trochanters and femora always bearing a large amount of yellow pile; fore and middle tibiæ always with considerable ferruginous pile on their outer sides; posterior tibiæ with outer faces convex and mostly naked, at least in the apical portion, and the fringes long and, for the most part, pale ferruginous; posterior metatarsi with rather long and ferruginous hind fringes.

Dimensions.—Length: queen, 13 mm. to 17 mm.; worker, 9 mm. to 13 mm.; male, 11 mm. to 14 mm. Spread of wings: queen, 29 mm. to 34 mm.; worker, 22 mm. to 28 mm.; male, 24 mm. to 29 mm. Width of abdomen at second segment: queen, 7 mm. to 9 mm.; worker, 5 mm. to 7 mm.; male, 6 mm. to 8 mm.

Redescribed from ten queens and many workers and males.

Habitat.—I have records of this species as follows: Alaska (Yukatat, Virgin's Bay, Sitka, Ft. Wrangel, Seldovia, Ju-

neau, Popoff Island, Fox Point and Urca), British Columbia (Mt. Cheam, Skagway District, Comox, Metlakatla, Vancouver), Washington (Mt. Rainier, Olympic Mountains, Seattle and Pullman), Oregon (Mt. Hood), Idaho (Lolo Trail, Bitter Root Mountains) and California (Fieldbrook). It is probably present in Yukon Territory, western Alberta, western Montana and northwestern Wyoming. What are its northern, eastern and southern limits? It appears to be pretty strictly confined to the Pacific portion of the Boreal Region, and is apparently a common species throughout a considerable portion of its range. It probably is not to be found east of the Rocky Mountains.

The original description is complete and definite enough to plainly determine this species. The type specimens of *mixtuosus* are evidently typical *sitkensis*. The females and males above described should undoubtedly go together, as indicated by their similarity of appearance and concordance of habitat.

This species is by far most closely allied to *B. mixtus* Cress. on one side and to *B. ambiguus* on the other. The females can apparently always be separated from those of *mixtus* by means of their somewhat longer pile and their dark scutellum. The males of the two species can be at once separated by the striking difference between the flagella of their antennæ.

Bombus (Bombus) mixtus Cress.

Bombus mixtus Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 186, ♀ ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308. (Catal.).
" *frigidus* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., VI, 1891, p. 454 (pars.).
" *mixtus* Titus, Can. Ent., XXXIV, 1902, pp. 39 and 44, ♀.
" *oregonensis* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 126.
" " Ashmead, Hym. of Alaska, 1904, p. 132.
" *mixtus* Cockerell, Univ. Color. Studies, IV, 1907, p. 257.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Types.—Queen and worker from Colorado, in the collection of the American Entomological Society; male (described as *B. frigidus* by Cresson) in the same collection.

Pile of medium length. Face bearing yellow pile; occiput and dorsum of thorax back to scutellum bearing a mixture of yellow and black pile; outlines of black interalar band somewhat indefinite; scutellum yellow; pleura yellow to bases of legs; dorsum of abdomen yellow at base, black in middle and yellowish-ferruginous at apex; corbicular fringes more or less ferruginous; malar space short.

Queen. Head.—Triangular in outline; face and occiput bearing a mixture of yellow and black pile; sides behind eyes usually entirely black. Labrum with very large tubercle-like areas, their slightly concaved summits smooth and the shelf-like projection between them very small. Malar space shorter than its width at the apex, not more than one-fifth as long as the eye. Clypeus almost entirely smooth, except at the coarsely punctate corners. Flagellum of antennæ scarcely twice as long as scape; third antennal segment distinctly longer than fifth, fourth and fifth subequal.

Thorax.—Anterior part of dorsum covered with yellow and black pile mixed in varying proportions; black interalar band wide, but rather indefinite, there being considerable yellow mixed with the black on the sides; scutellum usually pure yellow, but often with a slight admixture of black hairs; the very center of the disc bare, smooth and shining, and often surrounded by a small but noticeable amount of ferruginous pile; pleura covered with yellow to bases of legs; sides of median segment sometimes covered with yellow, sometimes with black pile.

Abdomen.—Dorsum: first segment covered with yellow pile; second segment with only the basal middle bearing yellow hair, the remainder being black, or all degrees of variation from this to having this segment entirely covered with yellow; third segment entirely black or apical portion covered with deep ferruginous, or yellow-ferruginous pile; fourth segment sometimes black on anterior corners, but usually entirely ferruginous; fifth and sixth segments entirely yellow or yellowish-ferruginous. Venter sparsely clothed with light pile. Hypopygium without median carina.

Wings.—Subhyaline, only slightly stained with brown; fore wings darkest on median and submedian cells, on anterior portion of radial cell and in region beyond the veins.

Legs.—Apices of coxæ and trochanters bearing considerable light pile; femora sometimes entirely black, but usually bearing more or less light pile, often nearly to their apices; fore and middle tibiæ black on their inner sides, but usually with considerable ferruginous hair on their outer sides; fringes of corbiculæ usually more or less strongly ferruginous, rarely entirely black; tarsi usually more reddish than

those of most *Bombus* species; hind metatarsi bearing only short spines and pubescence, except for a posterior basal fringe of short hairs and a scattering of hairs of about the same length on the basal portion of their outer sides,

Worker.—Much like the queen, but with no distinct black interalar band present; pile of dorsal apical segments of abdomen, as a rule, much more distinctly ferruginous; second segment, on a good share of the specimens, entirely yellow; basal part of fourth segment often bearing black pile; wings somewhat lighter than those of queen, scarcely tinged at all with brown; fore and middle tibiæ and corbicular fringes usually black; tarsi not especially reddish.

Male. Head.—Shaped and colored much like that of queen and worker, but, in the majority of specimens, with pile of face and occiput pure yellow—in some, however, with a strong admixture of black hairs; sides of head behind eyes with a large amount of yellow pile, this connecting with the yellow on the occiput. Labrum transversely concaved in front; malar space hardly one-fourth as long as eye; clypeus mostly covered up with pile. Flagellum of antennæ (fig. 19) about three times as long as scape, somewhat suddenly thickened at base and tapering toward apex; basal segments with prominent tufts of hair on outer side, these tufts also present on apical segments, but with hairs so short as not to be very noticeable; third and fifth antennal segments subequal in length, fourth shorter than either.

Thorax.—Coloration of pile about as in worker, but many specimens with anterior part of dorsum pure yellow; black interalar band very indefinite.

Abdomen.—Dorsum: first two segments entirely covered with yellow pile; third segment entirely black; fourth segment usually with basal portion black and apical portion ferruginous, in some specimens entirely ferruginous; fifth, sixth and seventh segments ferruginous, sometimes some black hair on the apical segment. Venter clothed with long yellow pile.

Genitalia.—Outer spatha variable, usually like that of *B. vagans* (fig. 131). Inner spatha shaped much like that of *B. fervidus* (fig. 101) and sometimes with small fenestræ. Claspers (figs. 108 and 109) with branches rather narrow and squarely rounded at the tip as seen from dorsal side; volsellæ appearing truncate at tip and with rounded apical projections; squamæ rounded triangular, with pointed tips; sagittæ with nearly straight shafts.

Wings.—About as in worker.

Legs.—Coxæ, trochanters and femora bearing a considerable amount of yellow pile. Fore and middle tibiæ and corbicular fringes varying from almost entirely black to somewhat strongly ferruginous mixed with black. Outer faces of posterior tibiæ convex and considerably bare; fringes long and forming distinct corbiculæ. Posterior meta-

tarsi bearing only short spines and pubescence, except for a posterior fringe of rather long hairs.

Dimensions.—Length: queen, 11 mm. to 15 mm.; worker, 7 mm. to 11 mm.; male, 8 mm. to 11 mm. Spread of wings: queen, 27 mm. to 31 mm.; worker, 17 mm. to 25 mm.; male, 21 mm. to 25 mm. Width of abdomen at second segment: queen, 8 mm. to 8½ mm.; worker, 4 mm. to 7 mm.; male, 4½ mm. to 6½ mm.

Redescribed from twelve queens (one a homotype), twenty-seven workers (two homotypes) and eleven males.

Habitat.—I have records of this species from Alaska, British Columbia, Alberta, Saskatchewan (in the old sense), Vancouver Island, Labrador, Washington, Idaho, Montana (western part), Oregon, California (Humboldt County), Wyoming and Colorado. Is it present in southern California, Nevada, Utah, or northern New Mexico? What is its most southern limit in central and eastern Canada? Is it to be found in northern Minnesota, northern Michigan, or northern Maine? Though not very rare in western Montana, it is probably not present in the eastern part of that state or in any of the states east of those from which the records have been given above. It seems to be a pretty strictly Boreal Region form, apparently reaching its greatest abundance in Alaska and northwestern Canada, though not very rare in eastern, central or southwestern Canada or in parts of Washington, Montana, Wyoming, or Colorado. My most northern record is Seldovia, Alaska (Harriman Expedition—Trevor Kincaid collection—several specimens). How far north does the species range?

This species is closely allied to *B. alboanalis*, but can be readily separated from it by the mixed yellow and black pile on the anterior part of the dorsum of the thorax and by the prominent tufts of hair on the basal segments of the flagellum of the male antennæ. Other close allies are *sitkensis* and *couperi*.

As has already been shown, the species is somewhat variable. I have seen specimens (five queens and eleven workers) from a nest collected at Bozeman, Montana, and among them there was but little variation.

I have the following evidences that the male here described

is the male of *mixtus*, and not that of *frigidus* as was supposed by Cresson:

1. *Similarity of coloration.*—Its thoracic dorsum, except the scutellum, bears mixed black and yellow pile like the *mixtus* worker. The worker also often has the second dorsal abdominal segment entirely covered with yellow pile.

2. *Similarity of distribution.*—It is found wherever the females of *mixtus* are found and in corresponding abundance.

Bombus (Bombus) alboanalis nom. nov.

? *Bombus hortorum* Smith, Entom. Annual, 1857, p. 30 (misidentification).
" " Cresson, Proc. Ent. Soc. Phila., 1863, p. 108.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231. (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *sitkensis* Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 126 (misidentification).
" " Ashmead, Hym. of Alaska, 1904, p. 132.
? " " Viereck, Can. Ent., XXXVI, 1904, pp. 98 and 99.

Types.—Described from eight queens (cotypes) and twelve workers (cotypes), deposited in the collection of the United States National Museum. Eleven worker paratypes are also in the same collection. One queen and one worker (paratypes) are in the collection of the Massachusetts Agricultural College.

Pile rather long and of medium texture. Face dark; occiput variable in coloration; thorax with dorsum yellow, except for black interalar band; lower portions of pleura dark; abdomen with dorsum yellow at base, black in the middle and white at the apex; wings rather light. Malar space rather short.

Queen. Head.—Face entirely dark; occiput entirely dark, or with black and yellow pile mixed, or even with a triangular patch of pure yellow pile; cheeks dark. Labrum with tubercle-like areas moderately separated, their margins rounded and summits strongly concaved; the shelf-like projection moderately wide and prominent. Malar space shorter than its width at the apex, about one-fifth as long as the eye. Clypeus sparsely and unevenly punctate over the disc. Flagellum of antenna about twice as long as the scape; third antennal segment distinctly longer than the fifth, the fifth slightly longer than the fourth.

Thorax.—Dorsum covered with yellow pile, except for a rather broad and usually well defined black interalar band; the center of the disc

naked; mesopleura with their upper portions yellow, but at least their lower halves dark; metapleura dark, but usually with a little yellow pile at their upper ends; sides of median segment dark, but often with a sprinkling of light hairs.

Abdomen.—Dorsum: segment one clothed with yellow pile, rather sparsely so in the middle; segment two sometimes with the basal middle broadly covered with yellow pile and the remainder dark, sometimes with the basal half yellow and the apical half dark and sometimes with the yellow extending back in the middle to the apical margin with the black extending forward on the sides; segment three entirely dark; segment four usually with the basal portion dark and the apical portion bearing white pile, but sometimes entirely dark; segments five and six covered with white pile. Venter mostly dark, but with the apical margins of some of the segments often fringed somewhat with light hairs. Hypopygium without a median carina.

Wings.—Only slightly stained with brown; the fore pair darkest in the apical portion of the radial cell and in the region beyond the veins.

Legs.—Usually entirely dark, but the corbicular fringes sometimes strongly ferruginous and the pile on the coxæ and trochanters often with light tinges.

Worker.—Much like the queen; the wings subhyaline; the fifth dorsal abdominal segment sometimes entirely dark; the second dorsal segment often nearly or entirely covered with yellow pile. Thorax with mesopleura often covered with yellow pile to the bases of the legs and the metapleura often largely clothed with yellow pile. The apical segments of the venter often with some whitish pile. Coxæ, trochanters and the bases of the femora occasionally with a noticeable amount of light pile.

Dimensions.—Length: queen, 13 mm. to 15½ mm.; worker, 9 mm. to 13 mm. Spread of wings: queen, 28 mm. to 32½ mm.; worker, 19½ mm. to 28 mm. Width of abdomen at second segment: queen, 6½ mm. to 8½ mm.; worker, 4½ mm. to 6½ mm.

Habitat.—I have North American records of this species from Alaska only, as follows: Kukak Bay, Kadiak and Popoff Island (all collected by Prof. Kincaid on the Harriman Alaskan Expedition). I also have the following Asiatic records: Bering Island (Dr. L. Stejneger), Copper Island (Barrett-Hamilton). It seems to be a fairly common species in Alaska.

I have seen many specimens of *B. hortorum* (L.) from Sweden and Germany, determined both by Gerstaecker and Schmiedeknecht. Some of these specimens had the basal

middle of the second dorsal abdominal segment bearing yellow pile, their coloration thus being very similar to that of this species. The two species do not seem to be closely allied, however, because of the differences noted in the following table:

Queen of *B. alboanalis*.	Queen of *B. hortorum*.
Malar space short, about one-fifth the length of the eye. Yellow pile on the second dorsal abdominal segment about covering the anterior half of the segment. Interalar band narrow. Occiput variable in coloration.	Malar space long, one-half the length of the eye. Yellow patch on base of second dorsal abdominal segment about as in *bimaculatus*. Black interalar band very broad. Occiput dark.

I have seen a few workers of *B. montanus* Lep., determined by Gerstaecker, and that species seems to be very closely allied to *alboanalis*, and it is possible that they should be considered as variations of the same species. I find no structural differences between them, and the only difference in coloration of pile is that the black interalar band of *montanus* is wider than that of *alboanalis*. *B. mixtus* Cress. seems to be the closest New World ally of this species.

True *B. hortorum* does not occur in the New World, and it is probable that Smith's record of *hortorum* from Lake Winnepeg should be referred either to this species, the locality labels of Smith's specimens having been incorrect, or possibly to *B. mixtus*.

THE DUMOUCHELI GROUP.

"The group of *B. Dumoucheli* Radoszkowski, Bull. Soc. Natural. Moscou, XLIX, P. I, 1884, p. 78.

Type.—*Bombus dumoucheli* Radoszkowski, ibid., p. 78, ♀ ♂, T. 3, fig.27.

Characters of the Group.

Females.—Pile rather coarse and of medium length; head elongate triangular in outline (fig. E); mandibles as in *Pratorum* group; malar space of good length; clypeus more or less strongly punctate; hypopygium without median carina.

Males.—Head (fig. F) elongate triangular, with long malar

space; antennæ long and slender; posterior tibiæ with outer surface distinctly convex and bearing little or no long hair; traces of corbiculæ very slight or absent; posterior metatarsi bearing no long hair, their outer faces distinctly concaved and with thin but usually fairly even pubescence.

Genitalia.—Claspers (figs. 66, 70 and 78) thick and powerful, appearing rather short; branches very wide at base and narrowing very rapidly toward the apical portion, as seen from above; volsella very broad and thick, with long triangular recurved apical projection; squama usually with a very prominent inner lobe: this lobe usually being elongate in form and widened and rounded at the end and having a noticeable membrane run from it to the base of the volsella. Sagitta with head irregular in form, broad, thin, recurved and usually with a serrate outer margin; not especially broad and nearly straight.

Bombus (Bombus) fervidus F.

Apis fervida Fabricius, Suppl. Entom. System., 1798, p. 274, n. 43 and 44.

Bombus fervidus Fabricius, Syst. Piez., 1804, p. 352, n. 48.

" " Illiger, Magaz. f. Insectenk., V, 1806, p. 172.

" " Harris, Catal. Insects Mass., 1835, p. 70. (Catal.).

" " Lepeletier, Hist. Nat. Insect. Hymen., I, 1836, p. 470, n. 8, ♀.

" " Greene, Ann. Lyc. Nat. Hist. New York, VII, 1860, p. 171, n. 5, ♀.

" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 93, n. 10, ♀ ☿ ♂.

" " Putnam, Proc. Essex Instit., IV, 1864, p. 99 (pars.).

" " Packard, Proc. Essex Instit., IV, 1864, p. 110 (pars.).

" " Riley, Am. Ent. and Bot., II, 1870, p. 303, ♀.

" " Cresson, Rep. Geogr. and Geol. Explor. and Surv. 100th Merid., 1875, V, p. 728, n. 131, ♂.

" " Putnam, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 189.

" " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210.

" " Cresson, Trans. Amer. Ent. Soc., VII, p. 230. (Catal.).

" " *dorsalis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Bombus fervidus Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " Provancher, Natural. Canad., XIII, 1882, p. 267, n. 2.
" " Provancher, Faun. Ent. Can. Hym., 1883, p. 735, n. 2, ♀ ☿ ♂.
" *dorsalis* Cresson, Syn. Hym. No. Amer., 1887, p. 307. (Catal.).
" *fervidus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 237 (pars.).
" " Howard, Insect Life, I, 1889, p. 295.
Apathus elatus Howard, Insect Life, 1889, p. 295.
" " Coville, Proc. Ent. Soc. Wash., I, 1890, p. 201.
Bombus fervidus Robertson, Ent. News, I, 1890, p. 41.
" " Coville, Proc. Ent. Soc. Wash., I, 1890, p. 201.
" " Smith, Economic Entomology, 1896, fig. 473, b and f, ♀.
" " Dalla Torre, Cat. Hym., X, 1896, p. 519 (pars.).
" " var. *dorsalis* Dalla Torre, Cat. Hymen., X, 1896, p. 519.
" " Robertson, Trans. Ac. Sci. St. Louis, VII, 1897, p. 356.
" " Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 387.
" *nevadensis* race *aztecus* Cockerell, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 389.
" *fervidus* Cockerell, The Entomologist, XXXII, June, 1899, p. 157.
" " Titus, Can. Ent., XXXIV, 1902, pp. 38 and 40, ♀ ☿ ♂.
? " " Fowler, Rep't Cal. Agr'l. Exp. Sta., 1902, Part XII, p. 317.
" " Meehan, Proc. Ac. Nat. Sci. Phila., LIV, 1902, p. 35.
? " " Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
? " *dorsalis* Titus, Can. Ent., XXXIV, 1902, pp. 37 and 39.
" *nevadensis* race *aztecus* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *pennsylvanicus* Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 177.
" " Viereck, Can. Ent., XXXVI, April, 1904, p. 98.
" *fervidus* Howard, Insect Book, 1904, p. 12 ; Plate II, fig. 12.
" " Jarvis, Thirty-sixth Ann. Rep't Ent. Soc. Ont., 1905, p. 128.

Bombus ferviotus Kellogg, American Insects, 1905, p. 519.
" *dorsalis* Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 238.
? " *fervidus* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *dorsalis* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906. p. 313,
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, p. 453, n. 111.
" *fervidus* Smith, Economic Entomology, 1906, fig. 473, b and f, ♀.
" " Lovell, Ent. News, XVIII, May, 1907, pp. 197-198, ♀ ☿ ♂.
" *pennsylvanicus* Swenk, Ent. News, XVIII, July, 1907, p. 296, n. 2.
" *dorsalis* Cockerell, Univ. Color. Studies, IV, 1907, p. 258.
" *fervidus* Cockerell, Univ. Color. Studies, IV, 1907, p. 258 and p. 257.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 16.
" " Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Pile of medium length and coarse. Head black; thorax mostly yellow, sometimes with and sometimes without a black interalar band; pleura sometimes light and sometimes partly dark; dorsum of abdomen with the first four segments yellow and the last two black; venter black; legs black. Malar space moderately long.

Queen. Head.—Rather elongate; face black, but sometimes with a very faint touch of yellow hair above the bases of the antennæ (visible with a lens); occiput black and sides black. Labrum with tubercle-like areas well separated, the space between them and above the shelf-like projection being deeply excavated, their summits more or less strongly concave; the shelf-like projection rather wide and prominent; translucent areas (in mounted labrum) distinctly visible to the naked eye. Malar space longer than its width at apex, about one-third as long as the eye. Clypeus rather coarsely punctate, except on anterior median portion, this part being nearly smooth. Flagellum of antenna not quite twice as long as the scape; third antennal segment much longer than fifth, the fifth somewhat longer than the fourth.

Thorax.—Anterior part of dorsum and the scutellum covered with yellow pile; a black band of greatly varying width between the bases of the wings; center of disc naked; mesopleura sometimes covered with yellow pile to the bases of the legs, but usually with more or less of the lower part black; metapleura often entirely dark, but usually with some light hair at the upper end; sides of median segment usually entirely dark, but often with more or less light pile.

Abdomen.—Dorsum : first four segments entirely covered with yellow pile ; segments five and six black. Venter black. Hypopygium without a median carina.

Wings.—Very strongly stained with brown ; the fore pair lightest in and around the third cubital and the apical half of the third discoidal cell, darkest in the median, submedian, basal portion of second discoidal and anterior portion of radial cell.

Legs.—Coxæ, trochanters, femora and tibiæ dark.

Worker.—Like the queen, but with wings usually lighter ; metapleura and sides of median segment often bearing only light pile.

Male. Head.—Shaped much like that of queen ; face usually, and ventro-lateral portions sometimes, with a very faint sprinkling of yellow hairs (only noticeable with a lens), otherwise black. Malar space much longer than its width at apex, about one-third as long as the eye. Clypeus largely naked and usually with a somewhat larger smooth area on the anterior median portion than in the queen. Flagellum of antenna from three and one-half to four times as long as scape ; third antennal segment distinctly shorter than the fifth, the fourth shorter than the third.

Thorax.—Like that of the queen, in coloration of pile, but with the pleura always entirely covered with light pile to the base of the legs ; sides of median segment usually with light, but sometimes with dark pile.

Abdomen.—Dorsum : first five segments entirely covered with yellow pile ; segment six sometimes entirely black, but usually with a little yellow on the basal middle ; segment seven entirely black. Venter mostly black, but usually with considerable light pile on the sides of the middle portion.

Genitalia.—Outer spatha much like that of *B. pennsylvanicus* (fig. 126). Inner spatha (fig. 101) with apical portion quadrangular and with ventral surface of sides and tip, of this portion, bearing moderately long hairs ; no fenestræ present ; lateral margins broadly and evenly incurved. Claspers and sagittæ as in *B. californicus* (figs. 78 and 102).

Wings.—Not very deeply stained with brown, much lighter than those of queen ; the fore pair darkest in the region beyond the veins.

Legs.—Coxæ sometimes entirely dark and sometimes with a little light pile ; trochanters sometimes entirely dark, but usually with a small amount of, and often with much, light hair ; fore femora sometimes entirely dark, but usually with considerable light pile, especially on the basal portion of their lower sides ; middle and hind femora always with a large amount of light yellow pile throughout, or nearly throughout, their entire length ; tibiæ black, outer faces of hind pair convex and hairy, their fore and hind fringes very short ; posterior metatarsi with no long hind fringes.

Dimensions.—Length: queen, 15 mm. to 21 mm.; worker, 8 mm. to 15 mm.; male, 10 mm. to 16 mm. Spread of wings: queen, 37 mm. to 41 mm.; worker, 17 mm. to 35 mm.; male, 25 mm. to 33 mm. Width of abdomen at second segment: queen, $8\frac{1}{2}$ mm. to $10\frac{1}{2}$ mm.; worker, $3\frac{1}{2}$ mm. to 8 mm.; male, 6 mm. to 8 mm.

Each sex described from a large number of specimens.

Variation.—Besides the typical species above described, there is the following:

Subspecies 1.—(*dorsalis* Cress. and *aztecus* Ckll.). Queen, worker and male with dorsum of thorax completely covered with yellow pile, no black interalar band being present; sixth dorsal abdominal segment of male often entirely yellow.

The typical *fervidus* grades completely into this form. I have examined the genitalia of the males and they are like those of the typical form. This subspecies is found most abundantly in the western United States, but it also occurs rarely in the East. I have over thirty specimens of this form before me, two of them homotypes.

Habitat.—This species is present throughout all the states of the United States, except as follows: Florida, Louisiana, Alabama, Mississippi, the greater part of Texas, the eastern half of Oklahoma, the greater part of Arkansas, the greater part of Georgia, the eastern half of North and South Carolina, eastern Virginia and the western portions of Tennessee and Kentucky. I have records of it also from Canada as follows: Ontario, Alberta (McLeod), Saskatchewan (the old territory) and the old territory of Assiniboia (Regina). It is also almost certainly present in Manitoba. Is it present in southern Quebec and in New Brunswick? Bowles has recorded it from Montreal. What are its northern limits? Does it range into northern Mexico at all and, if so, how far? The species seems to be confined mainly to the Transition and Upper Austral Zones, but it runs over somewhat into the Boreal Region. It appears to be the most common species throughout a good portion of the New England, Middle Atlantic and Central States, but much less abundant in the Pacific States. Dr. Davidson states that it is "the most common of all the bumble-bees in the vicinity of Los Angeles," Cal. He states further that it is most abundant

on the Pacific shore, but is not at all common in the interior of California, though ranging inland to the New Mexican border.

Nests.—I have taken a large number of nests of this species and they have been found invariably on the surface of the ground and made, as usual, of dried grass. They never contain a large number of bees. The largest nest, which I have found, contained seven queens, three males and thirty-seven workers and was taken September 7th. This nest contained, besides the adult bees, 88 unbroken cells, of which 47 were queen cells; there were also many well filled honey pots or cells. In another nest, I found one queen, two males and thirty workers, besides 125 unbroken cells and 25 honey pots. This nest was taken July 22d and promised, if not disturbed, to have made an unusually populous colony. The nests of this species are the ones most commonly found by the New England farmer during the haying season. They more than make up in number for what they lack in size.

The nearest ally of this species is *B. californicus*, as I have shown in the discussion of that species. Another very closely allied form is *B. sonomæ*, described in this paper for the first time.

As I have shown in the discussion of *pennsylvanicus*, I cannot agree with Robertson and others that this species is the same as the *pennsylvanicus* of De Geer.

Bombus (Bombus) californicus F. Sm.

Bombus californicus Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 400, n. 57, ♀ (not the ♂).
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 97, n. 18, ♀ (not the ☿ and ♂).
" *dubius* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 97, n. 19, ☿ ?.
" *californicus* Cresson, Rep. Geogr. and Geol. Explor. and Surv. 100th Merid., 1875, V, p. 728, n. 129, ♀.
Apathus? californicus Cresson, Trans. Amer. Ent. Soc., VII, 1879. p. 214, ♂. (Catal.).
" *californica* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Bombus californicus Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

" *dubius* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Apathus? californica Cresson, Syn. Hym. No. Amer., 1887, p. 307. (Catal.).

Bombus californicus Cresson, Syn. Hym. No. Amer., 1887, p. 307. (pars.) (Catal.).

" *dubius* Cresson, Syn. Hym. No. Amer., 1887, p. 307. (Catal.).

" *consanguineus* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 239, ♀ ☿ ♂.

" *californicus* Ant. Handlirsch, Ann. naturh. Hofmus. Wien., III, 1888, p. 243, ♀ (not the ☿ and ♂).

" " Dalla Torre, Cat. Hym., X, 1896, p. 513 (pars.).

" *consanguineus* Dalla Torre, Cat. Hym., X, 1896, p. 514.

" *dubius* Dalla Torre, Cat. Hym., X, 1896, p. 518.

Psithyrus californicus Dalla Torre, Cat. Hym., X, 1896, p. 566. (Catal.).

Bombus " Cockerell, Cat. Abej. de Mex., 1899, p. 19. (Catal.).

" " Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317.

" *dubius* Titus, Can. Ent., XXXIV, 1902, p. 40.

" sp. Jordan and Heath, Animal Forms, 1902, p. 130, fig. 80, ☿.

" *neglectulus* Ashmead, Proc. Wash. Acad. Sci., IV, May 29, 1902, p. 124, ♀ ☿.

" " Ashmead, Hym. of Alaska, 1904, p. 130, ♀ ☿.

" *californicus* Howard, Insect Book, 1904, Plate II, fig. 15, ♀.

" " Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.

" " Cockerell, Bull. So. Cal. Ac: Sci., III, June, 1904, p. 89.

Psithyrus californicus Cockerell, Bull. So. Cal. Ac. Sci., III, June, 1904, p. 90.

Bombus californicus Kellogg, American Insects, 1905, p. 518, fig. 722, and p. 519, and Plate XII, fig. 10, ♀.

" *dubius* Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, p. 453, n. 113, Dec. 17, 1906.

" *californicus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 16.

" " Fletcher and Gibson, ibid., 1908, p. 111.

" " Cockerell, Can. Ent., XLII, 1910, p. 25.

" " Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Types.—The queen is in the collection of the British Museum. The males (described by Cresson as *Apathus? californicus*) are in the collection of the American Entomological Society. Both the queen and the male type specimens were from California.

Head black; anterior part of dorsum of thorax covered with yellow pile; wings deeply stained with brown; two apical abdominal segments black; color characters of thorax, abdomen and legs very variable—see below under "Variation"

Queen. Head.—Sometimes with a slight trace of light pile mixed with the black on the face, above the bases of the antennæ, otherwise with dark pile only. Labrum much as in *B. affinis*, but with borders of tubercle-like areas rounded and much less sharply elevated; translucent areas sometimes large enough to be plainly visible to the naked eye, sometimes nearly absent. Malar space about one-third as long as the eye. Clypeus rather evenly, sparsely and finely punctate. Third antennal segment much longer than fifth, fifth distinctly, but not greatly, longer than fourth.

Thorax.—Anterior part of dorsum covered with yellow pile back to the middle of the tegulæ; posterior part, including scutellum, covered with black pile. Pleura, from somewhat below the level of the bases of the wings in front, entirely covered with black pile; sides of median segment bearing only black pile.

Abdomen.—Dorsum, except fourth segment, bearing only black pile; fourth segment entirely covered with yellow pile. Venter sparsely clothed with black hair.

Wings.—Deeply stained with brown; fore wings darkest at median and submedian cells and on anterior and apical portions of the radial cell and on the general apical region beyond the veins.

Legs.—Coxæ black; trochanters usually black, but often with pile having a distinctly light tinge; femora black; fore and middle tibiæ and corbicular fringes black; hind metatarsi, for most part, bearing only pubescence and short spines, with a slight fringing of short hairs on the posterior border near the base.

Worker.—Much like queen except in size; wings usually somewhat lighter.

Male. Head.—Face above and below bases of antennæ bearing yellow and black pile mixed in varying proportions, the black being always present in very noticeable amount and often predominant; occiput with a prominent triangular patch of yellow pile, with or without black hair intermixed; sides of head behind eyes with more or less yellow pile; hair immediately surrounding the upper ends of the eyes black. Malar space between one-third and one-fourth as long as the eye; clypeus not covered up with pile, rather sparsely and finely

punctate on the disc, the central apical portion being impunctate, smooth and shining; fifth antennal segment nearly as long as the third and fourth taken together, third distinctly though not greatly longer than fourth.

Thorax.—Coloration much as in females, but with the yellow pile on the anterior part of the thorax extending down on the front sides of the pleura, in a narrowing strip to, or nearly to, the bases of the middle legs; posterior part of the mesopleura and the metapleura covered with dark pile.

Abdomen.—Dorsum covered with black pile, except segments four and five, these being covered with yellow pile. Venter bearing black pile for most part, but with the yellow of dorsal segments four and five extending onto the extreme sides of the corresponding ventral segments and onto the extreme sides of the posterior margin of segment three; apical segment with a prominent transverse carina a little in front of its hind margin, the area between this carina and the margin bearing short ferruginous hair.

Genitalia. — (Figs. 78 and 102). Apical portion of inner spatha quadrangular; heads of sagittæ short and with apices so strongly recurved as to appear like hollowed out shells.

Wings.—Not very deeply stained with brown, considerably lighter than those of queen.

Legs.—Fore coxæ black; middle and hind coxæ mostly black, but usually with some yellow hairs on their outer sides; trochanters mostly black, sometimes with a very faint sprinkling of yellow; femora, fore and middle tibiæ and outer sides of hind tibiæ black.

Dimensions.—Length: queen, 15 mm. to 22 mm.; worker, 9 mm. to 15 mm.; male, 12 mm. to 16 mm. Spread of wings: queen, 37 mm. to 44 mm.; worker, 24 mm. to 31 mm.; male, 26 mm. to 35 mm. Width of abdomen at second segment: queen, 9 mm. to 11 mm.; worker, $5\frac{1}{2}$ to 9 mm.; male, $5\frac{1}{2}$ mm. to $7\frac{1}{2}$ mm.

Redescribed from numerous queens, eight workers and four males (one of them a homotype).

Variation.—The above described forms comprise the typical *californicus* and they are the forms most frequently found in collections. The species is, however, a very variable one and the typical forms are really a part of a line of color variations from dark to light. I have seen almost every conceivable variation connecting the following female and male forms in order:

Color Variant 1.—Queen like typical *californicus*, but with abdomen entirely black. One specimen from Prince Albert, Saskatchewan.

Color Variant 2.—Worker like typical *californicus*, but with fourth

segment only partly covered with yellow pile. Three specimens; Calgary and St. Albert, Alberta and San Bernadino County, Calif.

Color Variant 3.—Typical *californicus* (above described).

Color Variant 4.—(*B. dubius* Cress.). Queen and worker like typical *californicus*, but with yellow pile more or less strongly mixed with the black on the scutellum. Several specimens from California, Oregon, Washington and Colorado.

Color Variant 5.—Queen and worker like Color Variant 4, but with scutellum well covered with yellow pile, so as to have a definite black interalar band, and with yellow pile extending down some distance on the pleura, in front of the wings, and with basal segment of abdomen covered with yellow. Two specimens; queen from Vancouver and worker from Magdalena Mountains, New Mexico.

Color Variant 6.—(*B. consanguineus* Handl.). Queen like Color Variant 5, but with basal middle of second and apical portion of third dorsal abdominal segment bearing yellow pile. Three queens; from Vancouver and Colorado.

Color Variant 7.—Queen like Color Variant 6, but with yellow on pleura nearly reaching the bases of the legs. One specimen from Vancouver.

Color Variant 8.—Queen like Color Variant 7, but with thorax bearing black pile only on the interalar band and abdomen with a rather faint fringing of yellow hairs on the apical margin of the second dorsal segment. One specimen from Pullman, Washington.

Color Variant 9.—Queen like Color Variant 8, but with apical half and extreme side margins of third dorsal abdominal segment covered with yellow pile and with apical margin of the second segment strongly fringed with yellow; femora bearing considerable yellow hair. (In general appearance, this color variant is strongly suggestive of *B. fervidus* F.). One specimen from Pullman, Washington.

Male Color Variant 1.—Like typical male, but with yellow pile on pleura not nearly reaching bases of legs, and the fourth dorsal abdominal segment bearing yellow pile only on its apical portion. Two specimens from California.

Male Color Variant 2.—Like the typical male, but with pleura of thorax bearing yellow pile to bases of legs, scutellum and basal dorsal segment of abdomen covered with yellow pile and with only the apical margins of dorsal segments four and five bearing yellow hair. One specimen from British Columbia.

Male Color Variant 3.—Typical male (described above). Specimens from California.

Male Color Variant 4.—(*B. consanguineus* Handl.). Like Male Color Variant 2, but with dorsal abdominal segments four and five completely covered with yellow, with the basal middle of dorsal segment two and the apical margins of segments two and three bearing

yellow pile and with the coxæ, trochanters and femora to their tips bearing a large amount of light hair; venter also bearing a considerable amount of light pile. Three specimens; from British Columbia, Nevada and California.

Male Color Variant 5.—Like Male Color Variant 4, but with first five dorsal abdominal segments, except basal middle of third, entirely covered with yellow pile; pile on apical segment somewhat ferruginous; hairs on tibiæ more or less strongly ferruginous; black interalar band narrow. Several specimens: from Wyoming, Idaho, and California.

Habitat.—I have records of this species from all the Pacific states and territories, except Montana and Arizona, from western Kansas, Lower California, Alaska (probably southern), British Columbia, Vancouver Island, Alberta and Saskatchewan. Judging from this distribution, it must also be present in Arizona, western Oklahoma, western Nebraska, Montana (though I have seen no specimens of it in three Schmitt boxes full of bumble-bees from that state) and Athabasca. It may be present in western Texas, western South Dakota and northern Mexico. My most northern record is Alaska; most eastern, Kansas; most southern, El Rosario in Lower California and Magdalena Mountains in New Mexico. It appears to be present in greatest abundance in California, Oregon and Washington, being in California one of the most common species. It seems to belong mainly to the Canadian and Transition Zones. Handlirsch's record, "New Orleans," is probably a mistake. Dr. Davidson states that, in southern California, it is "most commonly found on the coast beaches; less frequently in the San Bernardino Mountains up to 6000 feet altitude."

This species has by far its nearest ally in *B. fervidus* F., from which I have been unable to separate it structurally. There seems to be ground for supposing that sufficient collecting may show that these two species intergrade completely.

That the males here described go with the females of *californicus* Smith, I have the following evidences:

1. *Genitalia.*—By the genitalia, the males are at once and with certainty identified as *Bombus* males and as males of the *Dumoucheli* group.

2. *Similarity of appearance.*—These males resemble the females of *californicus* very closely in coloration and they vary in coloration in a corresponding manner. No other males known to me do this.

3. *Coördination of structure.*—The females are structurally the same as the females of *B. fervidus*, and these males are structurally the same as the males of *fervidus*.

4. *Concordance of habitat.*—These females and males are found ranging through the same habitat and in corresponding numbers in the different portions of it.

Bombus (Bombus) pennsylvanicus Geer.

Apis pennsylvanica De Geer, Mem. Hist. Insects, III, 1773, p. 575, n. 8; T. 28, F. 12.
" *americanorum* Fabricius, Syst. Entom., 1775, p. 380, n. 12.
" *pennsylvanica* Goze, De Geer: Abh. Gesch. Insect., III, 1780, p. 372, n. 8; T. 28, F. 12.
" *americanorum* Fabricius, Spec. Insect., I, 1781, p. 477, n. 13.
" *pennsylvanica* Retzius, Gen. and Spec. Insect., 1783, p. 61, n. 218.
? " *americanorum* Fabricius, Mant. Insect., I, 1787, p. 300, n. 14 (probably not a *Bombus*).
" " Olivier, Encycl. Method. Insect., IV, 1789, p. 66. n. 25.
" " Gmelin, Linné: Syst. Nat., Ed. 13ª, 1–5, 1790, p. 2784, n. 116 (pars.).
" " Christ, Naturg. d. Insect., 1791, p. 126.
" " Fabricius, Entom. Syst., II, 1793, p. 319, n. 18.
" *nidulans* Fabricius, Suppl. Entom. System., 1798, p. 274, n. 33–34.
Bombus americanorum Fabricius, Syst. Piez., 1804, p. 346, n. 16.
" *nidulans* Fabricius, Syst. Piez., 1804, p. 349, n. 35.
" " Illiger, Magaz. f. Insectenk., V, 1806, p. 172.
? " *americanorum* Illiger, Magaz. f. Insectenk., V, 1806, p. 172, n. 52, ♀.
Bremus " Jurine, Nouv. Meth. Class. Hymen., I, 1807, p. 260, ♀.
Centris " Lepeletier, Encycl. Method. Insect., X, 1825, p. 795.
Bombus " Harris, Catal. Insect. Mass., 1835, p. 70. (Catal.).
? " " Lepeletier, Hist. Nat. Insect., Hymen., I, 1836, p. 472, n. 22, ♀.
" " Greene, Ann. Lyc. Nat. Hist. New York, VII, 1860, p. 172, n. 9, ♀.
" *pallidus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 92, n. 8, ♀.

Bombus pennsylvanicus Cresson, ♀ ☿ (pars.), Proc. Ent. Soc. Phila., II, 1863, p. 94, n. 11 (not the ♂).

" *nidulans* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 107, n. 39 and p. 165.

Apathus elatus Cresson, Proc. Ent. Soc. Phila., 1863, p. 114, n. 7, ♂.

Bombus pennsylvanicus Packard, Proc. Essex Instit., IV, 1864, p. 111, ♀.

Apathus elatus Packard, Proc. Essex Instit., IV, 1864, p. 120, ♂.

Bombus pennsylvanicus Riley, Am. Ent. and Bot., II, 1870, p. 303, ♀.

Apathus elatus Cresson, Trans. Amer. Ent. Soc., IV, 1872, p. 285.

Bombus pennsylvanicus Cresson, Rep. Geogr. and Geol. Explor. and Surv. 100th Merid., 1875, V, p. 728, n. 128, ♀.

" " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210—also *A. elatus*.

Apathus elatus Cresson, Rep. Geogr. and Geol. Explor. and Surv. 100th Merid., VII, 1879, p. 230. (Catal.).

" " var. *nidulans* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Bombus pennsylvanicus Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

" " var. *americanorum* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

" " var. *pallidus* Cress., Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.

Apathus elatus Provancher, Natural. Canada., XIII, 1882, p. 269, n. 3, ♂.

" " Provancher, Faun. Entom. Canad. Hymen., 1883, p. 737, n. 3, ♂.

" " Cresson, Syn. Hym. No. Amer., 1887, p. 307.

Bombus pennsylvanicus, ♀ and ☿ (pars.), Cresson, Syn. Hym. No. Amer., 1887, p. 308 (not the ♂).

" " var. *pallidus* Cresson, Syn. Hym. No. Amer., 1887, p. 308.

Apis elata Cresson, Syn. Hym. No. Amer., 1887, p. 309.

" *nidulans* Cresson, Syn. Hym. No. Amer., 1887, p. 309.

Bombus americanorum Cresson, Syn. Hym. No. Amer., 1887, p. 309.

? *Psithyrus elatus* Provancher, Addit. Faun. Can. Hym., 1888, p. 343.

Bombus pennsylvanicus Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 238 (pars.).

" " Coville, Proc. Ent. Soc. Wash., I, 1890, pp. 202 and 238 (pars.).

Apathus elatus Coville, Proc. Ent. Soc. Wash., I, 1890, p. 202.

Bombus americanorum Robertson, Ent. News, I, 1890, p. 40.
Apathus elatus Robertson, Ent. News, I, 1890, p. 40.
Bombus americanorum Smith, Economic Entomology, 1896, fig. 473, e and g, ♀ ☿.
" " Dalla Torre, Cat. Hym., X, 1896, p. 510.
" *nidulans* Dalla Torre, Cat. Hym., X, 1896, p. 538.
" *pennsylvanicus* Dalla Torre, Cat. Hym., X, 1896, p. 539.
" " var. *pallidus* Dalla Torre, Cat. Hym., X, 1896, p. 539.
" *americanorum* Robertson, Trans. Ac. Sci. St. Louis, VII, 1897, p. 356 (also *B. nidulans*).
Psithyrus elatus Dalla Torre, Cat. Hym., X, 1896, p. 569.
Apathus elatus Smith, Economic Entomology, 1896, fig. 473 i, ♂.
Bombus americanorum Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, Vol. IV, 1889, p. 388.
" " Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71, ♀ ♂
Psithyrus cevalliæ Cockerell, Entomologist, XXXII, June, 1899, p. 157.
Bombus americanorum var. *pallidus* Meehan, Proc. Acad. Nat. Sci. Phila., LIV, 1902, p. 35.
" *titusi* Ashmead, Ent. News, XIII, 1902, p. 50.
" *Pennsylvanicus* Titus, Can. Ent., XXXIV, 1902, pp. 38 and 42, ♀ ☿ ♂.
" *Titusi* Titus, Can. Ent., XXXIV, 1902, pp. 38 and 42, ♂.
" *pennsylvanicus* Meehan, Proc. Acad. Nat. Sci. Phila., LIV, 1902, p. 35.
" *americanorum* Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 177, ♀ ♂.
" " Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 100.
" *pennsylvanicus* Howard, Insect Book, 1904, Plate I, fig. 29.
" *americana* Howard, Insect Book, 1904, Plate I, figs. 30, ♀, and 31, ♂.
Psithyrus elatus Kellogg, American Insects, 1905, Plate XII, fig. 4, ♂.
Bombus pennsylvanicus Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 238.
Psithyrus cevalliæ Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 312.
Bombus americanorum Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Smith, Economic Entomology, 1906, fig. 473, e and g, ♀ ☿.
Apathus elatus Smith, Economic Entomology, 1906, fig. 473 i, ♂.
Bombus fervidus Fairchild and Barrett, Proc. Ent. Soc. Wash., VIII, 1906, pp. 13 and 14, Plate I, ♀ ♂.

Bombus americanorum Cockerell, Univ. Color. Studies, IV, 1907, p. 257.

" *pennsylvanicus* Cockerell, Univ. Color. Studies, IV, 1907, p. 257.

" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Type.—Possibly in the National Museum at Stockholm, but I am not sure of it. I have carefully examined the type of *B. titusi* Ashmead, which is in the U. S. National Museum, and also a cotype of *P. cevalliæ*, which Prof. Cockerell has loaned me, and they are both nearly typical males of this species.

Head black; pleura, and usually the scutellum, of the females black; females with front part of dorsum of abdomen yellow and hind part black and wings and legs dark; males somewhat variable, but with the greater part of the dorsum of the abdomen yellow and the apex usually ferruginous.

Queen. Head.—Face, occiput and sides with black pile. Labrum with tubercle-like areas rounded, their flattened or only slightly concaved summits usually rather coarsely punctate; shelf-like projection between these areas wide and prominent; translucent areas faint or absent. Malar space about as wide at apex as long, about one-fourth as long as the eye. Clypeus rather coarsely punctate but having a tendency to be somewhat smooth on the very middle portion. Flagellum of antennæ about twice as long as scape; third antennal segment distinctly longer than fifth, the fifth longer than the fourth.

Thorax.—Front part of dorsum always yellow; region between bases of wings always black, with the center of the disc naked; scutellum usually all black, but sometimes bearing yellow and black pile mixed, rarely all yellow; mesopleura, from somewhat (sometimes considerably) below the level of the bases of the wings, black to the bases of the legs; metapleura and sides of median segment black.

Abdomen.—Dorsum: segment one occasionally entirely yellow, but usually with more or less black pile on the anterior portion, especially on the sides of this portion; segments two and three entirely yellow; segments four to six inclusive entirely black.

Wings.—Very dark; the fore pair darkest in the median, anterior part of the submedian, anterior part of the second discoidal, anterior part of the radial and about the apex of the radial, cells and in the region beyond the veins.

Legs —Black.

Worker.—Like the queen, but with wings usually somewhat lighter; mesopleura sometimes with as much as their upper half covered with yellow pile.

Male. Head.—Clothed as in queen, but usually with more or less very dark grayish pile about bases of antennæ, over clypeus and on ventro-lateral surfaces. Malar space longer than its width at apex, about one-fourth as long as the eye; clypeus, except middle of anterior part, usually pretty well covered up with pile; flagellum of antenna about four times as long as scape, its middle segments usually appearing somewhat arcuate when viewed laterally (fig. 17); fifth antennal segment much longer than the third, the third slightly longer than the fourth.

Thorax.—Anterior part of the dorsum as in queen; a black band of considerably varying width between the bases of the wings; scutellum sometimes entirely dark, but much more often well covered with yellow pile; mesopleura sometimes as in queen, but usually with a greater portion bearing yellow pile and sometimes entirely covered with it to the bases of the legs (this variation sometimes occurs in specimens from the same nest); metapleura sometimes entirely dark, sometimes entirely light (also in specimens from same nest); sides of median segment usually covered with light pile, but sometimes with dark.

Abdomen.—Dorsum: segment one usually entirely yellow, but sometimes with basal portion having a strong admixture of black hairs with the yellow (this variation often occurs in the same nest); segments two, three and four entirely yellow; segment five entirely black, entirely yellow, base yellow and apical portion black, or base yellow and apical portion ferruginous; segment six entirely black, entirely ferruginous, yellow and ferruginous mixed, black and ferruginous mixed, entirely yellow, or yellow and black mixed; segment seven black, ferruginous, or black and ferruginous mixed, but usually with more or less ferruginous pile. Venter sometimes entirely black and usually mostly black, but the hairs fringing the apical margins of the segments often with a more or less strongly light or ferruginous tinge, and the extreme sides of the middle segments (really the ends of the corresponding dorsal segments) often pretty well covered with yellow pile.

Genitalia.—Outer spatha (fig. 126) long, its anterior lateral projections long and rounded at the end, anterior margin deeply and evenly incurved, posterior margin broadly and evenly rounded, each side of ventral surface with a scattering patch of rather long hairs. Inner spatha (fig. 132) long, its apical portion square at the tip and constricted slightly a little ways in front of it; a single large, long, central fenestra present; ventral surface of apical portion bearing rather short hair all the way across. Claspers (figs. 66 and 70) as already described for the group. Heads of sagittæ more elongate, less shell-like, than those of *B. californicus* and *fervidus* (compare fig. 102). Genitalia as a whole not separable, by any noticeable character, from those of *B. sonorus* Say.

Wings.—Usually somewhat lighter than those of the worker, much lighter than those of the queen.

Legs.—Coxæ sometimes entirely black, but the middle and hind pair usually with some light pile; trochanters usually with more or less light hair on their lower sides, but the fore and middle pair sometimes entirely dark; fore femora often entirely dark, but usually with more or less light pile; middle and hind femora always bearing a large amount of light, usually whitish, pile; fore tibiæ sometimes almost entirely dark, but very often with a considerable amount of light ferruginous pile on their hind sides, especially toward their apices; middle tibiæ occasionally entirely dark, but usually with more or less ferruginous pile on their hind sides, at least toward their apices; hair on outer faces of posterior tibiæ sometimes entirely dark, but usually a good share of it more or less strongly ferruginous.

Dimensions.—Length: queen, 17 mm. to 22 mm.; worker, 12 mm. to 17 mm.; male, 14 mm. to 23 mm. Spread of wings: queen, 41 mm. to 45 mm.; worker, 30 mm. to 41 mm.; male, 35 mm. to 44 mm. Width of abdomen at second segment: queen, 10½ mm. to 12 mm.; worker, 5 mm. to 9 mm.; male, 7 mm. to 8 mm.

Redescribed from many specimens of each sex.

Habitat.—This species is common throughout the United States, east of the Rocky Mountains, except in some of the most northern ones; rare in southern Maine and probably absent in the northern part; fairly common in southern New Hampshire, but probably absent in the northern part (my most northern record is Hanover, in the Connecticut River Valley); rare in Vermont and probably absent in the Green Mountains; probably absent in northern Michigan and northern Minnesota. Is it present and, if so, rare or abundant in northern Wisconsin, North Dakota and northern Montana? It is present, but apparently rather rare, in southern Ontario (my most northern record being "Ottawa"). Bowles has recorded it from Montreal. Is it present in southern Assiniboia? It is fairly abundant at least in certain parts of the eastern two-thirds of Mexico (my most southern record is Oaxaca) and seems to be mainly an Upper and Lower Austral form, but it runs over into the Transition Zone considerably. I have three questionable records as follows: a male from California, a male from Washington and a female from Oregon. Certainly, if present at all west of the eastern border of the Rocky Moutains, it is extremely rare there. It is present in eastern New Mexico, eastern Colorado and

eastern Wyoming. Throughout the greater part of its habitat, this species is one of the most abundant of all those present.

Nests.—I have taken a considerable number of nests of this species. They are usually built in deserted mouse nests on the surface of the ground, being made of the usual material for such nests—dried grass loosely woven together. In these surface nests, I have seldom found more than a few bees. Sometimes, however, their nests are subterranean and, when this is the case, they often contain quite a number of bees. The largest nest of this species which I have ever taken, contained one queen, fifty-three workers and twenty-three males. This nest also contained seventy-eight cells with larvæ in them, of which eighteen were queen cells. In this nest, I also discovered the largest single roll of pollen which I have ever found in a bumble-bee nest; it measured 24 mm. in length by 12 mm. in diameter and weighed 3.59 grams. All the nests of this species, which I have known about, were in open grassland.

The male of this species, long known as *Psithyrus elatus*, has probably caused as much discussion as any bumble-bee in the Western Hemisphere. That it is the true male of *pennsylvanicus*, I am able to present the following proofs:

1. *Genitalia.*—Its genitalia mark it unquestionably as a true *Bombus* instead of a *Psithyrus*.

2. *Coördination of structure.*—The females of *pennsylvanicus* and *sonorus* are structurally the same. These males, though differing in color from those of *sonorus*, are the same in structure.

3. *Concordance of habitat.*—These males have the same range of habitat as do the females of *pennsylvanicus*, and they are taken in corresponding numbers in the different parts of that range.

4. *Social association.*—Whenever these males have been taken in a nest, it has been a nest of *pennsylvanicus* females.

There is nothing about De Geer's original description to make it certain whether his form was the species (*B. americanorum* F.) above described, or the one which I am calling *B. fervidus*, or the *B. auricomus* of Robertson. There has been considerable discussion over the figure which accompanied the original description, and most of the very recent writers on the group, apparently following Mr. Robertson's

idea in the matter, have placed *fervidus* as a synonym of *pennsylvanicus*. As I hold to the view that the figure in question does not represent *fervidus*, I will here give my reasons, as follows:

1. The figure represents a female showing more black on the apical portion of the abdomen than *B. fervidus* would ever show in a like position. A female of *pennsylvanicus*, as above described, or of *auricomus* would, however, in the same position show about the same amount of black pile in this region as is shown in the figure.

2. The figure represents a female with the black pile running up on the mesopleura nearly to the level of the bases of the wings. I have never seen such coloration of the mesopleura on any specimen of *fervidus* taken in the United States. This coloration of the mesopleura is, however, typical with *americanorum* and with *auricomus*.

3. That the scutellum of the figure is yellow, is an indication that *fervidus* was the species represented. This, however, is not proof, as there are specimens of both *americanorum* and *auricomus* before me with the scutellum completely covered with pure yellow pile.

4. Four dorsal abdominal segments are not represented in the figure as being covered with yellow pile as might be thought by superficial examination. What appears to be the first segment in the figure is somewhat darker colored than what appears to be the three following segments and this was evidently intended to represent the darker and, as is often the case with *americanorum*, mixed black and yellow portion of the first segment, and what appears in the figure to be the second segment was evidently the remaining pure yellow portion of the first segment. The abdomen shown in the figure also represents the abdomen of *auricomus* very well.

I have submitted this question, with the figure and specimens and all the arguments pro and con known to me, to eight different workers in entomology. Of these eight, six agreed with me and two were undecided. If the type specimen is still in existence and some European student of Bombidæ comes across it, he will confer a great favor on American workers by straightening this matter out definitely once for all. Until such time, however, it seems to me that we must either adopt the view given above (which is the same as the one first published by Cresson and held to by him), or consider *pennsylvanicus* and *auricomus* as being the same, or reject the name *pennsylvanicus* altogether. It would, perhaps, be wisest to drop the name *pennsylvanicus*, but, as

it has been so long in use for the species just described, I have decided to retain it for this species, though it is my opinion that De Geer's figure was really made from a specimen of *auricomus* Robertson. The queen of *auricomus* sometimes very closely approaches the size of De Geer's figure, while those of *fervidus* and *americanorum* never do so.

Bombus (Bombus) sonorus Say.

Bombus sonorus Say, Boston Journ. Nat. Hist., I, P. 4, 1837, p. 413, n. 1, ♀.
" " Le Conte, Ed. of Writ. of Th. Say. Ent., II, 1859, p. 787, n. 1.
" " Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 171, n. 6, ♀.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 95, n. 12.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" *pennsylvanicus* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 238 (pars.).
" " var. *sonorus* Dalla Torre, Cat. Hym., X, p. 539, 1896.
" *sonorus* Cockerell, Cat. Abej. de Mex., p. 19. (Catal.).
" " Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, Vol. IV, 1899, p. 388.
" " Titus, Can. Ent., XXXIII, 1902, pp. 38 and 44.
" " Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p. 89.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Type.—From Mexico; lost.

Pile of medium length and rather coarse in texture. Head black. Dorsum of thorax yellow, with or without a black interalar band; pleura black. Dorsum of abdomen of the females with the first three segments yellow and the last three black; of the males, with the first four segments yellow and the rest black. Venter black. Legs black, except sometimes those of the male. Wings dark, especially those of the queen.

Queen. Head.—Rather elongate; black. Labrum with tubercle-like areas widely separated, their margins rounded and summits coarsely punctate, the surface between them and above the shelf-like projection deeply excavated; shelf-like projection very wide and prominent; translucent areas faint or absent. Malar space about as long as its

width at the apex, about one-fourth as long as the eye. Clypeus rather coarsely punctate, but somewhat smooth on the very middle portion. Flagellum of antenna about twice as long as the scape; third antennal segment much longer than fifth, the fifth longer than the fourth.

Thorax.—Dorsum covered with yellow pile, except for a broad black interalar band, the yellow on the front part extending down on the sides to slightly below the level of the bases of the wings; the very center of the disc bare of pile as usual. Pleura black. Sides of the median segment black. The extreme sides of the metanotum very often with yellow pile (just behind the bases of the hind wings).

Abdomen.—First three segments of the dorsum yellow, the rest black. Venter black.

Wings.—Very dark, with slight violaceous reflections; the fore pair darkest on their basal portion and about the apex of the radial cell and usually lightest in the region beyond the veins.

Legs.—Black and with black corbicular fringes.

Worker.—Much like the queen, but usually with somewhat lighter wings; the fore pair often lightest across their middle portions.

Male. Head.—Mostly dark, but usually with an admixture of whitish hairs (noticeable under a lens) above and below the bases of the antennæ and over the clypeus and occasionally on the occiput and on the cheeks. Malar space somewhat longer than its width at apex, about one-fourth as long as the eye. Clypeus mostly covered up with pile. Flagellum of antenna about four times as long as the scape, its segments, except the basal ones, usually appearing somewhat arcuate when viewed laterally, much as in *B. pennsylvanicus* (fig. 17); fifth antennal segment much longer than the third, the third and fourth segments subequal in length.

Thorax.—Coloration of pile much like that of females.

Abdomen.—Dorsum with the first four segments covered with yellow pile and the last three entirely black. Venter black.

Genitalia.—Outer spatha (fig. 32) with anterior margin broadly and evenly incurved; the posterior and lateral margins broadly and evenly outcurved, sometimes nearly straight; the sides of the ventral surface, somewhat behind the middle, bearing rather long scattered hairs. Inner spatha (fig. 32) with the sides of the anterior margin slightly incurved and bent backward slightly; the side margins straight and converging rapidly to the anterior end of the quadrate apical portion; the hind margin of the apical portion sharply indented so as to form an acute lobe on each side; a very long narrow fenestra present, often running from somewhat behind the center of the spatha nearly to its apical margin; ventral surface with considerable rather long hair on the apical lobes and along the apical margin between them. Claspers and sagittæ not separable by any noticeable character from those of *B. pennsylvanicus* (figs. 66 and 70).

Wings.—Lighter, as a rule, than those of either the queen or the worker, but still deeply stained with brown and very dark for the wings of a *Bombus* male.

Legs.—Black; the hind coxæ sometimes with considerable yellow pile on their outer sides, and the femora often with much yellow hair.

Dimensions.—Length: queen, 17 mm. to 24 mm.; worker, 10 mm. to 17 mm.; male, 14 mm. to 17 mm. Spread of wings: queen, 40 mm. to 48 mm.; worker, 25 mm. to 37 mm.; male, 35 mm. to 37 mm. Width of abdomen at second segment: queen, $8\frac{1}{2}$ mm. to $11\frac{1}{2}$ mm.; worker, $4\frac{1}{2}$ mm. to 8 mm.; male, 7 mm. to $8\frac{1}{2}$ mm.

Redescribed from eleven queens, many workers and seven males.

Variation.—Most of the specimens from California have the yellow on the dorsum of the thorax encroaching more or less on the black band between the bases of the wings, and some specimens even have this band entirely obliterated, the dorsum being entirely covered with yellow pile. As this tendency to lose the interalar band is noticeable only on Californian specimens, it seems to me that the form with the band very nearly or entirely obliterated should be recognized as a subspecies. I will, therefore, give it the name *sonorus flavodorsalis* subsp. nov. The type specimens, one queen and one worker, are deposited in the collection of the American Entomological Society.

Habitat.—I have records of this species as follows: Texas (Devil's River, Kerrville, Llano and San Antonio), New Mexico (Silver City, Alamogordo, White Mountains and Forks of Ruidoso Creek), Arizona (Reef, Palmerlee and Huachuca Mountains), California (Palm Springs, Inyo County and San Piedro and Claremont, Los Angeles County), Mexico (San Luis, Cholula, San Luis Potosi, Morelia and Guadalajara), Lower California (Comondu, El Taste and San José del Cabo). This is mainly a Lower Austral form, but it apparently runs over into the Upper Austral Zone somewhat. Titus, on the authority of Ashmead, has included it in his list of Colorado species (Can. Ent., XXXIV, p. 44), but it seems extremely doubtful if it occurs in that State. How far south does it range in Mexico? What are its eastern and northern limits in the United States?

This species is very closely related to *B. pennsylvanicus* De Geer, but I cannot agree with Herr Handlirsch in believing them to be varieties of the same species. The yellow pile of *sonorus* is a much deeper yellow than that of *pennsylvanicus*, and the scutellum of the female *sonorus* is much more densely covered with yellow pile than the scutellum of any female specimen of *pennsylvanicus* which I have ever seen. The differences between the males of the two species are more striking than are the differences between the females. The third antennal segment of the *pennsylvanicus* male is slightly longer than the fourth, while the antenna of the *sonorus* male has these segments practically equal in length; the differences in the coloration of the pleura, apical dorsal abdominal segments and legs should also be noticed.

Subgenus **BOMBIAS** Robertson (genus).

Bombias Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 176.
" Viereck et als., Can. Ent., XXXVI, 1904, p. 97.
" Viereck, Trans. Amer. Ent. Soc., XXXII, 1906, pp. 224 and 240.
" Swenk, Ent. News, XVIII, 1907, p. 294.
Subgenus *Bombias* Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 161.

Type.—Bombus (*Bombias*) *auricomus* Robertson.

Robertson took certain species from the genus *Bombus*, as formerly recognized, and placed them in a separate genus, *Bombias*. He distinguished the females of the two genera, thus recognized by him, from each other entirely by means of the size and position of their ocelli. He distinguished the males by the difference in the size and position of the ocelli, the difference in the size of the eyes, the difference in the length of the malar space and the difference in the relative lengths of the basal segments of the flagellum of the antenna. The study of a large number of species has shown, however, that these differences are not constant. Certain of the *Bombias* species, which the writer has placed in the *Fraternus* group, grade up so closely to certain species of the *Dumoucheli* group of the subgenus *Bombus* that they could almost be included in that group. It is found, furthermore, that

the species, which Robertson placed in the genus *Bombias*, fall naturally into two apparently distinct and widely different groups, as shown particularly by the differences in the genitalia of the males. The differences between these two groups (viz., *Auricomus* and *Fraternus*) seem to strongly indicate that they have had separate origins. Their geographical distributions, as far as they have been worked out, seem to greatly strengthen this supposition. The differences in structure, used by Robertson to separate *Bombias* from *Bombus*, have evidently been independently evolved by the two *Bombias* groups. In the opinion of the writer, therefore, the name *Bombias* should be entirely suppressed, as it seems to stand not for a natural, but for an artificial, division of the old genus *Bombus*. However, as this division is convenient, though artificial, and as the writer hesitates to completely demolish a classification established by another worker, until other investigators have expressed opinions about the matter, *Bombias* has been reduced to a subgenus and retained in this paper. The writer regards the *Fraternus* group of the subgenus *Bombias* and the *Dumoucheli* group of the subgenus *Bombus* as being very closely related and as being the most primitive of all the groups of the genus *Bombus* present in the New World.

Distinctive Characters of the Subgenus Bombias.

Females with ocelli large and somewhat variable in position, but typically below the supra-orbital line, in the narrowest part of the front, the lateral ones farther from each other than from the margins of the eyes (fig. D); lower side of apical margin of mandibles usually protruding more strongly than in the subgenus *Bombus*. The apices of the hind metatarsi usually not drawn out into so prominent and acute a projection, behind the insertion of the second tarsal segment, as is the case in the subgenus *Bombus* (*rufocinctus* and *mexicensis* are two of the more notable exceptions to this).

Males with eyes more or less swollen (fig. G) and bulging out from sides of head; ocelli large, usually placed well below the supra-orbital line, the lateral ones usually not

much more than their diameter from the margins of the eyes; vertex usually narrow and appearing at least slightly depressed; third antennal segment as long as, or longer than, the fifth; malar space usually shorter than its width at the apex; volsellæ of genitalia long and, in the majority of the species, extending noticeably beyond the tips of the squamæ; hind metatarsi with long hind fringes.

Fore wing of both females and males with the transverse median vein (fig. 14) usually forming an acute inner angle with the median and usually not coalescing at the base with the base of the discoidal vein; hind wing with transverse median vein (fig. 15) usually curved somewhat, forming nearly a right angle with both the median and the anal vein.

The two New World groups included in this subgenus may be conveniently and briefly distinguished as follows:

Females with the disc of the clypeus finely and evenly punctate all over; the males with the third antennal segment as long as the fourth and fifth taken together.....**Auricomus.**

Females with at least the anterior part of the disc of the clypeus more or less smooth; the males with the third antennal segment at most not much longer than the fifth.....**Fraternus.**

THE AURICOMUS GROUP.

Type.—Bombus auricomus Robertson. This group is newly established in this paper.

Characters of the Group.

Females.—Base of labrum with transverse, narrowly interrupted ridge; clypeus finely and evenly punctate over entire surface.

Males.—Vertex above ocelli much narrower than space between eyes at ocelli; flagellum of antennæ not more than two and one-third times as long as the scape; third antennal segment as long as the fourth and fifth taken together; eyes greatly swollen; posterior tibiæ with outer faces somewhat concaved and covered with very fine short hair, with no bare area; posterior metatarsi less than three times as long as their greatest width, their outer faces somewhat concaved and finely and evenly pubescent.

Genitalia.—Branches of claspers (figs. 73, 82 and 83) short and very broad and square at apical end as seen from dorsal side; volsellæ columnar, squarish at apex and of nearly even width from about the ends of the branches to their apices; squamæ very long and unevenly divided, the inner lobe being a mere tooth at the base of the outer one; heads of sagittæ very narrow, straight, elongate, with thin, strongly serrate outer borders and with tips recurved ventrad; shafts of sagittæ straight; uncus unusually broad, especially the basal portion.

Bombus (Bombias) auricomus (Robertson).

? *Apis pennsylvanica* De Geer, Mem. Hist. Insects, III, 1773, p. 575, n. 8; T. 28, F. 12, ♀.

Bombus pennsylvanicus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 94, n. 11, ♀ (pars.), ☿ (pars.) and ♂.

" " Robertson, Ent. News, I, 1890, p. 40.

" *nevadensis* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 245, ♂; T. 10, figs. 3 and 11.

Bombias auricomus Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, pp. 176 and 177, ♀ ☿ ♂.

Bombus nevadensis Howard, Insect Book, 1904, Plate II, fig. 3, ♂.

Bombias auricomus Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 240.

" " Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 3.

Bombus auricomus Cockerell, Univ. Color. Studies, IV, 1907, p. 257.

Types.—I have not seen the specimens from which this species was described. They are probably still in Mr. Robertson's private collection.

Females with face dark; occiput with some yellow pile; anterior part of dorsum of thorax yellow; black between the bases of the wings; scutellum variable, usually having black and yellow pile mixed, but sometimes entirely black and sometimes entirely yellow; pleura mostly dark; dorsum of abdomen with the second and third segments yellow, the remainder mostly black; venter black; legs black; wings very dark. Males with face and occiput having considerable yellow pile; dorsum of thorax yellow, except for sometimes an indefinite black interalar band; pleura mostly yellow; dorsum of abdomen with the three basal segments yellow and the remaining segments black.

Queen. Head.—Face black; occiput with some yellow pile, but usually with a more or less strong admixture of black hairs with the yellow, very rarely entirely black; cheeks black. Front margin of

labrum broadly outcurved, the translucent areas usually only very faintly visible and often entirely absent. Malar space somewhat longer than its width at the apex, about one-fourth as long as the eye. Ocelli placed much below the supra-orbital line, in the narrowest part of the vertex. Flagellum of antenna somewhat less than twice as long as the scape; third antennal segment fully as long as the fourth and fifth taken together, the fifth slightly longer than the fourth.

Thorax.—Anterior part of dorsum covered with yellow pile; the region between the bases of the wings always black; the scutellum very rarely entirely black, more often entirely covered with yellow pile, but usually bearing a mixture of yellow and black pile, at least on the hind portion; the center of the disc naked. Mesopleura with yellow pile extending down some distance below the level of the bases of the wings, but their lower two-thirds black; metapleura and sides of the median segment entirely black; extreme sides of the metanotum sometimes with tufts of yellow pile (behind the bases of the hind wings).

Abdomen.—Dorsum: segment one black, but very often with some yellow pile on the hind corners; segments two and three yellow, but often with a small amount of black pile on the basal middle of the second; segments four, five and six black. Venter black. Hypopygium without a median carina.

Wings.—Very dark and with slight violaceous reflections.

Legs.—Black and with black corbicular fringes.

Worker.—Much like the queen.

Male. Head.—Face with considerable yellow pile above and below the bases of the antennæ and often with a faint sprinkling of it on the sides of the clypeus; occiput largely covered with yellow pile, this extending forward almost to the ocelli; cheeks often entirely black, but as often with considerable yellow pile connecting with the yellow on the occiput. Malar space about one-half as long as its width at apex. Clypeus mostly bare of pile except on the sides and base. The ocelli situated nearly half-way from the supra-orbital line to the bases of the antennæ, the lateral ones almost touching the margins of the eyes.

Thorax.—Dorsum usually yellow with a poorly defined black interalar band, but often with only a black spot on the disc and occasionally with only yellow pile; the center of the disc more or less bare. Mesopleura covered with yellow pile to, or very nearly to, the bases of the legs. The metapleura with lower portions dark and upper portions bearing yellow pile. The extreme sides of the metanotum with yellow pile (behind the bases of the hind wings). The sides of the median segment usually dark, but occasionally with some light pile.

Abdomen.—Dorsum: segment one usually covered with yellow pile, but often more or less black in the middle and in front, and rarely

almost entirely black as in the queen and worker; segments two and three yellow; segment four usually entirely black, but rarely partly covered with yellow pile; segments five, six and seven black. Venter mostly dark.

Genitalia.—Outer spatha (fig. 124) exceptionally long for its width; with anterior lateral projections broad and rounded at the end; the posterior margin very deeply incurved in the middle so as to make the apex strongly bilobate, the ventral surface of each lobe with somewhat scattered, rather short, brown hairs. Inner spatha (fig. 136) much like that of *nevadensis*. Claspers (fig. 83) and sagittæ as already described for the group; much like those of *nevadensis*, but the inner lobe of the squama broader and the outer lobe longer and more pointed at the apex than in that species.

Wings.—Lighter than those of the females, but very deeply stained with brown; unusually dark for wings of a bumble-bee male.

Legs.—Mostly dark, but the coxæ, trochanters and femora often with some light tinges and the hind fringes of the posterior tibiæ and middle and posterior metatarsi very often more or less whitish ferruginous; the middle tibiæ often with touches of light pile on their hind sides toward their distal ends. Posterior metatarsi about two and one-half times as long as their greatest width.

Dimensions.—Length: queen, 18 mm. to 22 mm.; worker, 14 mm. to 18 mm.; male, 16 mm. to 19 mm. Spread of wings: queen, 43 mm. to 47½ mm.; worker, 33 mm. to 42 mm.; male, 38 mm. to 42 mm. Width of abdomen at second segment: queen, 10 mm. to 11½ mm.; worker, 6½ mm. to 10 mm.; male, 8 mm. to 9 mm.

Redescribed from many queens and workers and six males.

Habitat.—The writer has records of this species as follows: Canada (probably southern Ontario), New York, Massachusetts (rather rare at Amherst), Connecticut, Pennsylvania, Maryland, New Jersey, Delaware, Virginia, North Carolina, Tennessee, Kentucky, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota (St. Paul), Missouri, Iowa, Texas (Greenville), Kansas, Nebraska, Colorado (Virginia Dale) and New Mexico (Magdalena Mountains—cf. H. L. Viereck in Trans. Amer. Ent. Soc., XXXII, 1906, p. 240). Extensive collecting will probably extend this habitat considerably. What are the northern and southern limits of the species? This seems to be mainly an Upper Austral form, but it runs over considerably into the Transition Zone on one side and the Lower Austral on the other.

This species has a very close ally in *B. nevadensis*, but I know of no other very closely related species in the Western Hemisphere. A discussion of the more striking differences separating the two species follows my description of *nevadensis*.

Bombus (Bombias) nevadensis Cress.

Bombus nevadensis Cresson, Trans. Am. Ent. Soc., V, 1874, p. 102, ♀ ♂.
" " Cresson, Rep. Geogr. and Geol. Explor. and Surv. 100th Merid., 1875, V, p. 728, n. 130, ♀ ♂; T. 34, fig. 5.
" *improbus* Cresson, Proc. Ac. Nat. Sci. Phila., 1878, p. 186, ♂.
" *nevadensis* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" *improbus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *nevadensis* Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 245, ♀ ☿.
" *improbus* Dalla Torre, Cat. Hym., X, 1896, pp. 526, 538.
" *nevadensis* Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
" " race *cressoni* Ckll., Annals and Magazine of Nat. Hist., Ser. 7, IV, Nov., 1899, p. 388.
" *improbus* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 389.
" *nevadensis* Cockerell, Entomologist, XXXII, June, 1899, p. 156.
" " Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317.
" " Ashmead, Proc. Wash. Ac. Sci., IV, 1902, p. 124.
" " Titus, Can. Ent., XXXIV, 1902, pp. 37 and 40, ♀ ☿ ♂.
" " Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 44.
" " Viereck, Can. Ent., XXXVI, April, 1904, p. 98.
" " Ashmead, Hym. of Alaska, 1904, p. 130.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, p. 453, n. 117.
" " Cockerell, Univ. Color. Studies, IV, 1907, p. 258, ♀ ♂.

Bombus nevadensis Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.
Bombias nevadensis Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 4.
Bombus " Cockerell, Can. Ent., XLII, 1910, p. 25.
" " Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Types.—Queen from Nevada and in the collection of the American Entomological Society; male collected in Arizona by Mr. Henshaw and possibly in the collection of the Museum of Comparative Zoölogy at Cambridge though I did not see it there. The type specimens of *improbus* are in the collection of the American Entomological Society.

Pile rather short, fine and dense. Dorsum of thorax yellow with dark disc. Head of females black; their pleura mostly black; their abdomen with the three first dorsal segments yellow and the rest black; their legs black and malar space medium. Males with face, occiput and pleura yellow and apex of abdomen ferruginous.

Queen. Head.—Symmetrical elongate trapeziform in outline as viewed from in front. Face mostly black, but usually with very faint touches of yellow hair about the bases of the antennæ; occiput usually covered with mostly black pile, but with a more or less strong admixture of yellow hairs; sides of head, behind the eyes, black. Labrum with tubercle-like areas very large, almost meeting at the middle line and flat and coarsely and sparsely punctate at summit, the translucent areas variable and often absent; mandibles (fig. 30) usually with no indication of a fourth tooth on the lower side of the apical margin, usually rather protruding and rather sharply rounded in that region; malar space distinctly longer than its width at apex, more than one-fourth as long as the eye; ocelli as in *auricomus*; flagellum of antennæ from one and two-thirds to two times as long as the scape; third antennal segment fully as long as the fourth and fifth together, the fifth slightly longer than the fourth.

Thorax.—Dorsum with disc naked, smooth and shining, this bare area often having more or less black hair mixed with the yellow pile surrounding it; otherwise entirely covered with pale yellow pile of greatly varying shade. Mesopleura with yellow pile extending down onto them considerably below the level of the bases of the wings, but their lower parts always covered with black pile to the bases of the legs; metapleura and sides of median segment always black.

Abdomen.—Dorsum: segment one usually mostly covered with yellow pile, but sometimes with only a fringe of yellow on its hind border and always with more or less black pile on the upper portion of its front face, over (in front of) the apparent anterior margin, and the

extreme side margins usually with a little black pile; segment two usually entirely covered with yellow pile, occasionally with black pile extending up over the extreme side margins a little; segment three like segment two, but with more of a tendency to have black pile on the extreme side margins; three apical segments entirely black. Venter black. Hypopygium without median carina.

Wings.—(Fig. 14). Dark brown, with extremely slight violaceous reflections; the fore pair lightest in the apical portion of the third discoidal cell and in the region beyond the veins; hind pair lightest in the basal portion of the second discoidal cell and in the submedian cell.

Legs.—Coxæ, trochanters, femora and tibiæ black; outer faces of hind and middle metatarsi black, except apices, these being ferruginous.

Worker.—Like the queen, but wings usually somewhat lighter and thorax occasionally with a poorly developed black interalar band.

Male. Head.—Rounded triangular in outline. Face covered with a patch of pale yellow pile, with dark hairs more or less strongly admixed, especially over the clypeus, the black pile often predominant. Occiput with a triangle of pale yellow pile, often with more or less black hairs admixed; ventro-lateral surfaces of head usually entirely dark, but often with considerable light pile, this connecting with the occipital triangle. Labrum bituberculate somewhat as in queen, but the tubercular areas less marked; malar space about one-half as long as wide at apex; clypeus, except area immediately back of anterior border, covered up with pile; lateral ocelli separated by less than one-half their diameters from the inner margins of the eyes, all three situated nearly half-way from the supra-orbital line to the bases of the antennæ.

Thorax.—Dorsum sometimes entirely yellow, but as often with the disc more or less black, sometimes even with enough black to suggest an interalar band. Mesopleura always covered with yellow pile to bases of legs. Metapleura and sides of median segment sometimes with only dark pile, sometimes with only yellow and sometimes with yellow and dark mixed.

Abdomen.—Dorsum: first three segments yellow; segment four usually entirely black, but sometimes with a fringe of light hairs on the apical margin; segment five usually entirely black, but sometimes with pale yellow or light ferruginous pile on the sides; segments six and seven usually entirely covered with ferruginous (of greatly varying shade) pile, but the former sometimes partly or entirely black. Venter very variable, sometimes mostly dark and sometimes mostly light.

Genitalia.—Outer spatha (fig. 100) comparatively long and strongly bilobed at apex, each lobe rather pointed at the end and bearing rather short hairs over its ventral surface; margin between lobes deeply

incurved so as to be almost semicircular; anterior border widely and rather deeply incurved; lateral margins incurved somewhat at bases of terminal lobes; anterior lateral projections rather broad and rounded. Inner spatha (fig. 139) fully twice as wide as long; front border unusually thickened with chitin; hind portion broadly trapeziform and unusually wide, with two scattered patches of rather short hair on each side of the ventral surface, the anterior ones on slight lobations in the side margins and the posterior ones on the sides of the apex; margin of apex slightly incurved. Claspers and sagittæ (figs. 73 and 82) as already described for the group; much resembling those of *auricomus*, but the inner lobe of the squama much narrower than in that species and the outer lobe longer and more pointed at apex.

Wings.—Somewhat lighter than those of workers, only moderately stained with brown; the fore pair darkest in the median and submedian cells and in the region beyond the veins.

Legs.—Coxæ, trochanters and posterior femora sometimes entirely black, but as often with a large amount of light pile on their lower sides; anterior and middle femora sometimes mostly dark, but always with more or less light pile, at least on the lower side of their basal portions; fore and middle tibiæ often entirely dark, but usually with more or less ferruginous or pale yellow pile on their posterior sides, especially toward the apices; fringes of hind tibiæ occasionally entirely black, but usually more or less strongly ferruginous; the fore fringes rather short and the hind ones only moderately long; posterior metatarsi about two and one-half times as long as their greatest width, and with long, light yellowish or ferruginous fringes.

Dimensions.—Length: queen, 18 mm. to 22 mm.; worker, 15 mm. to 18 mm.; male, 13 mm. to 17 mm. Spread of wings: queen, 42 mm. to 48 mm.; worker, 38 mm. to 42 mm.; male, 32 mm. to 37 mm. Width of abdomen at second segment: queen, 9½ mm. to 12 mm.; worker, 9 mm. to 9½ mm.; male, 7 mm. to 8½ mm.

Redescribed from numerous queens (two of them homotypes), six workers and nine males (one a homotype of *improbus*).

Habitat.—I have records of this species from British Columbia, Alberta, Washington, Montana, California, Nevada, Colorado, Arizona and New Mexico. It must also be present in Idaho, Oregon, Wyoming and Utah. Dr. Ashmead recorded it as present in Alaska, and I think that this is probably correct, my most northern record being Fort Macleod, British Columbia. Mr. M. H. Swenk reports the species as ranging east in Nebraska as far as West Point, and this seems to indicate that it is present in the Dakotas and the

Canadian provinces to the north of them. Is it present in western Kansas and western Minnesota? In California, it probably is not to be found, except in the northern and eastern portions of the state. What is its northern limit in Canada and Alaska? My most southern record is Mescalero, New Mexico. It is mainly a Boreal and Transition form, but it runs over somewhat into the Upper Austral Zone. The species appears to be most abundant through the latitude of Montana and Washington, where it is fairly common.

The only close ally of this species, at least in the Western Hemisphere, is *B. auricomus* Robertson. The females of that species can readily be separated from those of *nevadensis* by their broad black interalar band and by their black first dorsal abdominal segment. The males can be separated structurally, as has been already shown, by differences in the squamæ of the genitalia and, furthermore, the apical dorsal segments of the abdomen of the *auricomus* male are black.

That the male known as *improbus* Cresson is the male of *nevadensis*, I have the following proofs:

1. *Similarity of appearance.*—These males look much more like the queens of *nevadensis* than do any others known to me that have the same habitat.

2. *Coördination of structure.*—The females of *nevadensis* are very closely related to those of *auricomus*, as shown both by structure and appearance, and the *improbus* males are correspondingly closely related to the males of *auricomus*, as shown by their structure and appearance.

3. *Concordance of habitat.*—These females and males have been taken in the same portions of North America and in corresponding abundance in the various regions.

THE FRATERNUS GROUP.

Type.—Bombus fraternus Smith. This group is newly established in this paper.

Characters of the Group.

Females.—Labrum with tubercle-like areas widely separated; clypeus with anterior part of disc more or less smooth, when punctate sparsely so and with rather coarse punctures.

Males.—Vertex above ocelli at most but very little narrower than space between eyes at ocelli (*fraternus* itself comes nearest to being an exception to this); flagellum of antennæ at least two and one-half times as long as the scape; third antennal segment at most not much longer than the fifth; the size of the eyes varying greatly between the different species; posterior tibiæ with outer face convex with at least a portion, especially toward the distal end, bare; posterior metatarsi more than three times as long as their greatest width (except in the case of *rufocinctus*), with long hind fringes.

Genitalia.—Branches of claspers (figs. 84, 85, 86, 87 and 88) long and rounded at apical end as seen from dorsal side; volsellæ variable, but narrowing toward the tip beyond ends of branches; squamæ usually comparatively short and chunky, the inner lobe well developed, being much larger, in comparison with the outer one, than in the *Auricomus* group; heads of sagittæ thin and more or less foliaceous, recurved ventrad and mesad, and often quite distinctly sickle-shaped, thus paralleling the *Pratorum* group of the subgenus *Bombus;* shafts of sagittæ usually bent outward slightly in the middle.

Bombus (Bombias) fraternus (F. Sm.).

Apathus fraternus Smith, Cat. Hym. Brit. Mus., II, 1854, p. 385, n. 6, ♂.

Bombus scutellaris Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 96, n. 15, ♀ ☿ ♂.

Apathus fraternus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 111, n. 3.

" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Bombus scutellaris Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230. (Catal.).

Apathus fraternus Cresson, Syn. Hym. No. Amer., 1887, pp. 307 and 308. (Catal.).

Bombus scutellaris Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 237.

" " Dalla Torre, Cat. Hym., X, 1896, p. 546. (Catal.).

Psithyrus fraternus Dalla Torre, Cat. Hym., X, 1896, p. 569. (Catal.).

Bombus scutellaris var. Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 390.
" " Titus, Can. Ent., XXXIV, 1902, pp. 38 and 41. ♂.
" " Ent. News, XIV, April, 1903, p. 132.
Bombias " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 177, ♀ ☿ ♂.
" " Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 224.
Bombus " Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Cockerell, Ent. News, XVIII, June, 1907, p. 265.
Bombias " Swenk, Ent. News, XVIII, July, 1907, p. 294, n. 2.

Types.—The male is in the collection of the British Museum; at least a part of the queen and worker type specimens are in the collection of the American Entomological Society.

Pile short and rather coarse. Wings dark. Anterior part of dorsum of thorax and scutellum yellow (females with a black interalar band); mesopleura mostly yellow; first two dorsal segments of abdomen yellow, the rest black; legs black. Malar space short.

Queen. Head.—Strongly rounded and black. Labrum with tubercle-like areas well separated, their summits strongly concaved and punctate and margins rather sharply elevated; median portion, above the shelf-like projection, deeply excavated; shelf-like projection broad and prominent; translucent areas faintly visible to the naked eye; anterior margin outcurved and slightly suggestive of *Psithyrus*. Malar space somewhat less than one-half as long as its width at apex. Ocelli placed well below the supra-orbital line (fig. D). Flagellum of antennæ nearly one and two-thirds times as long as the scape; third antennal segment somewhat shorter than the fourth and fifth taken together, the fourth shorter than the fifth.

Thorax.—Anterior part of dorsum and scutellum covered with yellow pile, a broad black band between the bases of the wings; center of disc naked and shining. Mesopleura mostly covered with yellow pile, but the yellow only very rarely reaching the bases of the legs. Metapleura and sides of median segment dark.

Abdomen.—Dorsum: segment one mostly clothed with yellow pile, but with some black hair on the corners of the anterior face (in front of the apparent front margin); segment two clothed with yellow pile, the hind border of the yellow being distinctly, though not deeply, notched in the middle (in the most perfect specimens); remaining segments black. Venter dark. Hypopygium without a median carina.

Wings.—Very dark. The fore pair with distinct, but not strong, violaceous reflections; lightest in the region beyond the veins and darkest

in the median, submedian, basal part of second discoidal and distal-anterior part of the radial cells.

Legs.—Dark; corbicular fringes dark; hind fringes of posterior metatarsi short throughout.

Worker.—Much like the queen.

Male. Head.—Broadly rounded. Face mostly dark, but often with a strong sprinkling of yellow hairs; occiput with a triangle of yellow pile, often with black hairs strongly admixed; cheeks mostly dark, but often with a sprinkling of yellow hairs. Mandibles (fig. 38) very scantily bearded. Malar space but little more than a mere transverse line. Clypeus pretty well covered up with pile. Eyes greatly swollen. Ocelli placed at more than one-third of the distance from the supra-orbital line toward the bases of the antennæ, each lateral one separated from the inner margin of the eye by less then one-half its own diameter. Vertex between the eyes slightly narrower above, than at the ocelli. Flagellum of antennæ between two and one-third and two and one-fourth times as long as the scape; third and fifth antennal segments equal in length, the fourth shorter.

Thorax.—Dorsum sometimes entirely covered with yellow pile, sometimes with the disc more or less black and sometimes with a distinct black band between the bases of the wings; mesopleura covered with yellow pile to, or nearly to, the bases of the legs; metapleura usually clothed with yellow pile, but occasionally dark; sides of median segment sometimes with yellow and sometimes with dark pile.

Abdomen.—Dorsum: segments one and two covered with yellow pile; segment three black, but often with slight touches of yellow on the sides; segments four and five black; segments six and seven usually entirely black, but often with more or less ferruginous pile. Venter mostly black, but with middle portions of apical margins of segments fringed more or less with short light hairs.

Genitalia.—Outer spatha (fig. 11) large, quadrangular, with lateral margins slightly incurved and converging somewhat posteriorly; anterior margin broadly and strongly, but not deeply, incurved; hind margin with a large median, almost semicircular notch; anterior lateral projections broad and rounded at the end; ventral surface of posterior two-thirds hairy, the hair being thickest and longest on the sides. Inner spatha (fig. 22) with middle of front margin projecting forward very strongly, the greater part of this projection being heavily chitinized; side margins somewhat irregular and converging rapidly posteriorly; hind margin incurved somewhat; sides of apical portion of ventral surface densely hairy; with a noticeable chitinous thickening on each side of the middle line; sides of anterior margin heavily chitinized. Claspers (figs. 71 and 87) thick and powerful in appearance; the branches very broad and broadly rounded at the end as seen from dorsal side; squamæ large, the outer lobe of each rounded

and the inner lobe nearly one-half as large as the outer one; volsellæ long and rather slender, extending considerably beyond the tips of the squamæ. Sagittæ with broadly foliaceous sickle-shaped heads, the outer portions of their margins strongly serrate; shafts straight and somewhat hairy, especially toward their bases on their upper and outer sides; uncus tapering gradually, narrow except towards the base, this being fairly broad.

Wings.—Dark, but usually somewhat lighter than those of the queen.

Legs.—Dark. Posterior tibiæ with outer faces sometimes bare and sometimes with a sparse scattering of short hairs, their fore and hind fringes rather short. Posterior metatarsi about three and one-half times as long as their greatest width, with hind fringes long and usually mostly black, but often more or less ferruginous, especially toward the apical end; their outer faces flat, or slightly concaved, and strongly and evenly pubescent.

Dimensions.—Length: queen, 21 mm. to 25 mm.; worker, 13 mm. to 21 mm.; male, 13 mm. to 22 mm. Spread of wings: queen, 50 mm.; worker, 30 mm. to 42 mm.; male, 42 mm. Width of abdomen at second segment: queen, 11 mm. to 11½ mm.; worker, 6 mm. to 9 mm.; male, 9 mm.

Redescribed from six queens (two of them homotypes of *B. scutellaris* Cresson), a large series of workers (two of them homotypes of *scutellaris*) and eleven males.

Habitat.—This species ranges through the following states of the United States: Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, Oklahoma, Arkansas, the greater part of Tennessee and of North Carolina, Kansas, Missouri, Kentucky, the eastern half of Virginia and of Maryland, Delaware, a considerable portion of New Jersey (Gloucester County, Anglesea, Lakehurst and Lancaster), Nebraska, Iowa, Illinois, Indiana and a considerable portion of Ohio. It also occurs in the eastern part of Colorado (Fort Collins, Hugo, Berkeley) and of New Mexico (Las Vegas) and in the southern part of Michigan. It probably ranges through a considerable part of Mexico, and probably is present in portions of Arizona, eastern Wyoming, the southern half of South Dakota, southern Minnesota and southern Wisconsin and the western part of West Virginia. It would be interesting to know if it is present in the southeastern part of Montana, the extreme southern part of Ontario (in Canada), and in the

Hudson River Valley and on Long Island in New York. It seems to be confined pretty strictly to the Upper and Lower Austral Zones, being apparently much more abundant in the latter where, next to *B. pennsylvanicus*, it appears to be the most common species.

This species seems to have no very close allies in the Western Hemisphere, *B. separatus* Cress. and *B. mormonorum* apparently being most nearly related to it. It is one of our most constant species in its color characters.

I have not seen the type specimen on which Smith based his original description of this species, and I have no further information concerning it than has already been published, but the description given by Smith applies so well to the male above described that I have no doubt of their being the same, especially as no other form, belonging to the Bombidæ and known to me, could have been the one described by Smith. I have not seen the male which Cresson considered to be Smith's *B. fraternus*, but, as it came from Texas, it to, without doubt, belonged to the species above described.

Bombus (Bombias) separatus Cress.

Bombus virginicus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 87, n. 1, ♂ (not the ♀ and ☿).
" *separatus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 165, ♀ ☿ ♂.
" " Putnam, Proc. Essex Instit., IV, 1864, p. 101.
" " Packard, Proc. Essex Instit., IV, 1864, p. 114, ♀ ☿ ♂.
" " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210, also Putnam on p. 195.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879.
" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " McCook, Tenants of an Old Farm, 1885, p. 173.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" " Ant. Handlirsch, Ann. Naturh. Hofmus Wien., III, 1888, p. 229.
" *virginicus* Provancher, Addit. Faun. Canada. Hymen., 1888, p. 339, ♂.
" *separatus* Dalla Torre, Cat. Hym., X, 1896, p. 546.
" " Titus, Can. Ent., XXXIII, 1902, pp. 37 and 39, ♀ ☿ ♂.
" " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, pp. 176 and 177, ☿ ♀ ♂.

Bombias separatus Viereck, Can. Ent., XXXVI, April, 1904, p. 97.
" " Swenk, Ent. News, XVIII, July, 1907, p. 294, n. 1.
Bombus " Cockerell, Univ. Color. Studies, IV, 1907, p. 258.

Types.—From Illinois, Pennsylvania and Canada; in the collection of the American Entomological Society.

Pile short and rather coarse in texture. Dorsum of thorax and pleura clothed with yellow pile. Dorsum of abdomen with the first segment yellow; the second segment more or less brown-ferruginous on the basal portion, especially in the middle, the remainder being black; the remaining segments all black. Malar space short. Face, venter and legs of females black. Wings of queen dark.

Queen. Head.—Face black, but with a very faint sprinkling of light yellow hairs usually present above the bases of the antennæ; occiput usually entirely black, but often with touches of yellow pile; ckeeks black. Labrum with tubercle-like areas having their margins somewhat sharply elevated and their summits coarsely and somewhat sparsely punctate and slightly concaved; the surface between these areas, and above the shelf-like projection, deeply excavated; the shelf-like projection wide and prominent. Malar space shorter than its width at the apex, about one-sixth as long as the eye. Clypeus with disc sparsely and delicately punctate, almost smooth; the corners coarsely punctate. Ocelli as in *B. mormonorum*. Flagellum of antenna about one and four-fifths times as long as the scape; the third antennal segment much longer than the fifth, the fifth somewhat longer than the fourth.

Thorax.—Center of the disc naked, the dorsum otherwise being entirely covered with yellow pile; mesopleura always covered with yellow pile to, or very nearly to, the bases of the legs; at least the upper portions of the metapleura clothed with yellow pile; sides of the median segment sometimes with mostly black pile and sometimes with mostly yellow pile, but usually with a mixture of black and yellow hairs.

Abdomen.—Dorsum: segment one clothed with yellow pile; segment two with at least the basal middle, and often with the basal half, covered with brown-ferruginous or brownish-yellow pile, the rest of the segment being black; the remaining segments entirely black. Venter black.

Wings —Deeply stained with brown; the fore pair lightest across the middle and darkest in the region beyond the veins, often with very slight violaceous reflections.

Legs.—Black and with black corbicular fringes.

Worker.—Much like the queen, but with wings usually lighter; the second dorsal abdominal segment sometimes almost entirely covered with brown-ferruginous pile; the posterior femora sometimes with a noticeable amount of yellow pile.

Male. Head.—Rounded in outline as viewed from in front. Face argely clothed with yellow pile from near the lower margin of the clypeus to some distance above the bases of the antennæ, but usually with a more or less strong admixture of black hairs with the yellow; occiput largely covered with yellow pile; cheeks often entirely dark, but usually with more or less yellow pile connecting with the yellow on the occiput. Malar space about one-third as long as its width at the apex. Ocelli placed in the narrowest part of the vertex; the lateral ones separated from the margins of the eyes by about one-half their own diameters. Flagellum of antenna about three times as long as the scape; the third and fifth antennal segments about equal in length, the fourth much shorter than either.

Thorax.—The dorsum covered with yellow pile, but the disc often bearing more or less black hair; mesopleura covered with yellow pile to the bases of the legs; metapleura and sides of the median segment clothed with yellow pile.

Abdomen.—Coloration of pile of dorsum much like that of the worker, but the extreme side margins of the third segment often with touches of yellow. Venter mostly dark, but usually with more or less yellow pile, especially in the middle.

Genitalia.—Outer spatha (fig. 129) with anterior margin deeply incurved; the side margins strongly incurved in front, but broadly outcurved behind; the hind margin straight or somewhat incurved; the posterior portion of the ventral surface rather thickly set with moderately long, branching hairs. Inner spatha (fig. 127) with the sides of the anterior margin nearly straight and nearly in the same straight line; the side margins incurved slightly; the apical margin somewhat variable, but usually nearly straight; the apical portion of the ventral surface thickly covered with long, branched hairs; a large, elongate fenestra often present somewhat in front of the center. Claspers (figs. 85 and 90) with volsellæ tapering gradually toward their tips, their apical projections long, prominent, somewhat recurved and with more or less serrate margins; squamæ with lobes separated by an unusually shallow indentation of the inner margin; ends of branches rather strongly quadrate in appearance as seen from dorsal side. Sagittæ with rather wide shafts and very broad, rounded, foliaceous heads, the outer margins of the latter being more of less strongly serrate, especially at the base.

Wings.—Usually somewhat lighter than those of the worker, only moderately stained with brown.

Legs.—Coxæ mostly dark, but the hind pair usually with some yellow hair on their outer sides; trochanters mostly dark, but often with a little light pile; femora all with a large amount of yellow hair; fore and middle tibiæ dark, but often with some slightly ferruginous hair on their hind sides; hind tibiæ with outer faces mostly or entirely

naked, their fore fringes rather short and black and their hind fringes long and usually entirely black, but often with more or less light hairs. Posterior metatarsi about three and one-half times as long as their greatest width, and with long, mostly dark hind fringes; their outer faces somewhat concaved.

Dimensions.—Length: queen, 15 mm. to 20 mm.; worker, 11 mm. to 15 mm.; male, 12 mm. to 18½ mm. Spread of wings: queen, 39 mm. to 43 mm.; worker, 27 mm. to 38 mm.; male, 31 mm. to 35 mm. Width of abdomen at second segment: queen, 8½ mm. to 10 mm.; worker, 6 mm. to 8½ mm.; male, 6½ mm. to 8 mm.

Redescribed from many specimens of each caste, including three queens, one worker and two male homotypes.

Habitat.—I have records of this species as follows: Vermont (Bridport), New York, Massachusetts, Connecticut, Rhode Island, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Ohio, Michigan (Detroit, Maple), Indiana, Kentucky, Illinois, Wisconsin (Grand Rapids), Minnesota, Iowa, Missouri, North Carolina (Charlotte and Raleigh), South Carolina, Georgia, Florida (Capron and Miami), Alabama, Mississippi, Louisiana, Tennessee, Arkansas, Kansas, Nebraska, North and South Dakota, Montana, Wyoming, Colorado, Idaho, Washington (Pasco, Wawawai, Almota, Yakima City), Oregon (Echo and Corvallis) and Canada (probably southern Ontario, though Bowles has recorded it from Montreal). It is mainly a Transition and Upper and Lower Austral species, but it runs over into the Canadian Zone in some regions. It is most abundant in the Upper Austral Zone where it is common. It is a rather rare species in New England. It seems probable that extensive collecting will add considerably to the range of habitat given here. What are its northern and southern limits? Is it present in the old territory of Assiniboia, Texas, Oklahoma, California, Nevada, Utah, Arizona, New Mexico, or Mexico.

Nests.—F. W. Putnam (Proc. Essex Instit., 1864) states that this species makes its nests under old stumps and in situations similar to those in which the nests of *fervidus* are found. He also states that it is one of the more ferocious species when its nests are attacked.

This species has its closest relative in *B. mormonorum*.

Bombus (Bombias) mormonorum Franklin.

Bombus mormonorum Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 161, ♀ ☿ ♂.

Types.—Described from four queens (cotypes), many workers (all cotypes) and two males (cotypes). These specimens were all taken in Utah as follows: two queens, nineteen workers and two males from Beaver Valley (the contents of a nest); one other queen and one other worker also from Beaver Valley; one queen and one worker from Beaver Creek Hills; one worker from Beaver Cañyon and two from South Creek, Beaver County. All the type specimens deposited in the collection of the Museum of Brooklyn Institute, except a queen and worker in the collection of the Massachusetts Agricultural College and a queen and worker in the collection of the United States National Museum.

Pile short and of medium texture. Thorax clothed with yellow pile, with no trace of a black interalar band. Dorsum of abdomen with segment one yellow; segment two entirely yellow or with the apical margin black or the basal middle brown-ferruginous; the remaining segments mostly black. Corbicular fringes of females dark. Wings of females rather deep brown. Malar space short.

Queen. Head.—Face with considerable yellow pile mixed with the black about the bases of the antennæ; occiput with considerable yellow pile, but usually with more or less black hair admixed; cheeks dark. Labrum with tubercle-like areas having their hind (proximal) margins rather sharply rounded and summits considerably concaved, the region between them, and above the shelf-like projection, deeply excavated; the shelf-like projection rather wide and prominent. Malar space distinctly shorter than its width at the apex, less than one-sixth as long as the eye. Clypeus for the most part very delicately punctate over the disc. Each lateral ocellus about one-half as far from the supra-orbital line as from the nearest eye. Flagellum of antenna about one and four-fifths times as long as the scape; third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Dorsum clothed with yellow pile; mesopleura covered with yellow pile to the bases of the legs; metapleura mostly clothed with yellow; sides of the median segment sometimes entirely dark and sometimes clothed with light yellow pile, but usually with a mixture of dark and light hairs.

Abdomen.—Dorsum: segment one yellow; segment two covered with yellow pile, except for black on its apical margin; segment three black, but sometimes with slight touches of yellow pile on the extreme

side margins; segments four, five and six entirely black. Venter black. Hypopygium without a median carina.

Wings.—Rather dark brown; the fore pair darkest in the region beyond the veins.

Legs.—Coxæ and trochanters mostly dark; femora with more or less yellow pile on their lower sides; fore and middle tibiæ and corbicular fringes dark.

Worker.—Much like the queen, but the apical margin of the second dorsal abdominal segment often covered with yellow pile, and at least the basal middle brown-ferruginous, pile of this color sometimes covering the entire segment; segments three and four usually with strong touches of yellow pile on their extreme side margins; the sides of the median segment usually with pure, or nearly pure, pale yellow pile; the face, above the bases of the antennæ, and the occiput usually with purer yellow pile than in the case of the queen.

Male. Head.—Face and occiput mostly covered with whitish pile; cheeks with some whitish pile connecting with that on the occiput. Malar space about one-third as long as wide. Clypeus mostly covered up with whitish pile. Ocelli in the narrowest part of the vertex, the lateral ones separated by about one-half their own diameters from the margins of the eyes. Third and fifth antennal segments equal in length, the fourth much shorter than either; flagellum about two and three-fourths times as long as the scape.

Thorax.—Dorsum, pleura and sides of the median segment covered with whitish pile.

Abdomen.—Dorsum: segments one and two whitish; the remaining segments mostly dark, but with considerable whitish pile on the sides. Venter with mostly whitish pile.

Wings.—Much lighter than those of the females; somewhat stained with brown.

Legs.—Coxæ, trochanters and femora all clothed for the most part with whitish pile; fore tibiæ mostly dark; middle tibiæ mostly dark or with considerable whitish pile on their hind sides; hind tibiæ with outer faces mostly bare, their front fringes short and mostly dark, their hind fringes long and dark or whitish; hind metatarsi with long and more or less whitish hind fringes.

Dimensions.—Length: queen, 17 mm. to 21½ mm.; worker, 11 mm. to 17 mm.; male, about 13 mm. Spread of wings: queen, 41 mm. to 43 mm.; worker, 26 mm. to 37 mm.; male, about 34 mm. Width of abdomen at second segment: queen, about 9½mm.; worker, 5½ mm. to 8 mm.; male, about 7½ mm.

This insect is closely allied to *separatus*, and it is quite possible that it should be considered a subspecies or color variant of that species.

Bombus (Bombias) morrisoni Cress.

Bombus morrisoni Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 183, ♀ ☿ ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 308.
" *morrisonii* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 245, ♀ ☿ ♂.
" " Dalla Torre, Cat. Hym., X, 1896, p. 535.
" *morrisoni* Cockerell, Bull. Sci. Lab. Den. Univ., XI, 1898, p. 71.
" " Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 388.
" *morrisonii* Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317.
" " Titus, Can. Ent., XXXIV, 1902, pp. 37 and 39, ♀ ☿ ♂.
" *perplexus*, Titus, Can. Ent., XXXIV, 1902, pp. 37 and 39, ♂.
" *morrisonii* Viereck, Can. Ent., XXXVI, April, 1904, p. 98.
" " Howard, Insect Book, 1904, Plate III, fig. 36, ♀.
" *morrisoni* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, p. 453, n. 116.
Bombias " Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 5.
Bombus " Cockerell, Univ. Colo. Studies, IV, 1907, p. 258.
" *morrisonii* Davidson, Bull. So. Cal. Acad. Sci., X, 1911, p. 66.

Types.—Described from numerous specimens from Colorado, now in the collection of the American Entomological Society.

Pile short, rather coarse and dense. Dorsum of thorax covered with yellow pile; pleura of the females mostly, and of the males largely, covered with black hair. Anterior part of dorsum of abdomen yellow and apical part black. Females with venter and legs dark. Wings of queens very dark. A handsome species.

Queen. Head.—Comparatively wide for its length. Face entirely dark; occiput with a triangular patch of yellow pile, the hind part of this patch usually extending to the sides of the head; cheeks dark. Labrum with tubercle-like areas having their margins rounded and summits somewhat concaved; shelf-like projection rather wide and prominent; translucent areas faintly visible to the naked eye. Malar space shorter than its width at the apex, between one-fifth and one-sixth as long as the eye. Ocelli placed distinctly below the supra-orbital line. Flagellum of antenna somewhat less than twice as long

as the scape; third antennal segment somewhat shorter than the fourth and fifth taken together, the fifth longer than the fourth.

Thorax.—Dorsum covered with yellow pile, this pile reaching down onto the mesopleura to a little below the level of the bases of the wings; the remaining portions of the mesopleura black; the metapleura black, except for an inconspicuous tuft of yellow hairs usually present just below the base of each hind wing; sides of median segment entirely dark

Abdomen.—Dorsum: segment one clothed with yellow pile; segment two covered with yellow pile, but usually with black pile on the extreme side margins; segment three with a large patch of yellow pile nearly reaching the side margins at the base of the segment, but on the apical margin reaching only about half-way to the side margin on each side, the rest of the segment being black; segments four, five and six entirely black. Venter black.

Wings.—Very dark and with slight violaceous reflections; the fore pair darkest in the median, submedian and parts of the second discoidal cell, and in the anterior portion and about the apex of the radial cell, lightest in the region beyond the veins.

Legs.—Black.

Worker.—Much like the queen, but with somewhat lighter wings, and the yellow patch of pile on the third segment tending to cover more of the segment; face sometimes with a very slight sprinkling of yellow hairs above the bases of the antennæ.

Male. Head.—Face with a large amount of yellow pile above and below the bases of the antennæ, usually with a more or less strong admixture of black hairs; occiput largely covered with yellow pile; cheeks sometimes entirely dark, but usually with a considerable amount of yellow pile connecting with the yellow on the occiput. Malar space about one-half as long as its width at the apex. Clypeus clothed, but not very densely, with mostly yellow pile. Ocelli placed exactly in the narrowest part of the vertex, the lateral ones about half their diameters from the inner margins of the eyes. Flagellum of antenna fully three times as long as the scape; third and fifth antennal segments equal in length, the fourth shorter than either.

Thorax.—Coloration of pile much as in queen, but usually as much as the upper two-fifths of the mesopleura covered with yellow pile, and often even their lower portion with a slight sprinkling of yellow hairs admixed with the black.

Abdomen.—Dorsum: three basal segments entirely covered with yellow pile; segment four sometimes entirely black and sometimes with all but the apical margin covered with yellow pile, but usually mostly black with the basal middle bearing more or less yellow pile; segments five, six and seven entirely black. Venter mostly dark, but usually with more or less yellow pile along the middle line of some of

the segments, and sometimes with some yellow hair on the sides at about the middle of the abdomen.

Genitalia.—Outer spatha (fig. 31) with anterior margin broadly and evenly incurved; the side margins slightly outcurved; the hind margin strongly incurved in the middle, thus making the apex appear more or less bilobed; anterior lateral projections more or less pointed; ventral surface with short scattered hairs on each side of the apical half. Inner spatha (fig. 134) with sides of anterior margin curved backward; the side margins irregularly incurved; the apical portion slightly bilobed, its hind margin being slightly emarginate in the middle; ventral surface of apical portion, on the sides and along the middle line, bearing long, dense, branching hairs. Claspers (figs. 86 and 89) with volsellæ strongly constricted in the middle, their apical projections rather large, pointed and with serrate margins; outer lobes of squamæ much larger than the inner ones, the tips of both lobes rounded. The heads of the sagittæ quite broadly foliaceous; their shafts nearly straight.

Wings.—Very much lighter than those of the queen; without vioaceous reflections; at most not darker than light brown.

Legs.—Coxæ usually entirely dark, but sometimes with some yellow pile; the fore trochanters usually entirely dark and the middle and hind ones also sometimes so, but the middle and hind ones usually with more or less yellow pile on their lower sides; the fore and middle femora often with some yellow pile; the hind femora always with considerable yellow hair; fore and middle tibiæ entirely black; hind tibiæ with fringes black, the hind fringes being long and the front fringes rather short; hind fringes of posterior metatarsi long and mostly black; posterior metatarsi from three and one-half to four times as long as their greatest width.

Dimensions.—Length: queen, 17 mm. to 24 mm.; worker, 12 mm. to 17 mm.; male, 13 mm. to 21 mm. Spread of wings: queen, 45 mm. to 49 mm.; worker, 29 mm. to 40 mm.; male, 33 mm. to 40 mm. Width of abdomen at second segment: queen, 11 mm. to 12 mm.; worker, 6 mm. to 9 mm.; male, 7 mm. to 9 mm.

Redescribed from many qeeens (three of them homotypes), five workers (from Utah, Colorado and New Mexico) and six males.

Variation.—The workers of this species do not, as a rule, have, in all respects, the same coloration as the typical worker described above. I have seen every gradation between the typical worker and the color variant described below, which is the form most commonly met with in collections:

Color Variant.—Worker like the typical form, but with the third dorsal abdominal segment entirely, and very often also the basal middle of the fourth, covered with yellow pile. Many specimens from Arizona, New Mexico, Colorado and Utah.

Habitat.—I have records of this species from Colorado, Utah, Nevada, California (Chino, Los Angeles, Mt. Shasta), Arizona (Flagstaff and Southern Arizona) and New Mexico, and it probably ranges throughout the greater portion of the Transition Zone in those states. That it runs over into the Upper Austral Zone a little, is shown by the following records from western Nebraska: Warbonnet Cañon, Sioux County, and Gering (very rare) (Swenk in Ent. News, July, 1907). What are its northern and southern limits? Does it range into Mexico? My most northern record is Mt. Shasta, California, and my most southern is "southern Arizona." It seems to be a fairly common species throughout a considerable portion of its habitat.

This species is apparently most closely related to *B. crotchii*, with which, however, it does not seem to be very closely allied.

The queens of this species are very striking in appearance.

Bombus (Bombias) crotchii Cress.

Bombus crotchii Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 184, ♀.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 23 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" *nigrocinctus* Provancher, Addit. Faun. Canada. Hymen., 1888, p. 342, ♀.
" *crotchii* Dalla Torre, Cat. Hym., X, 1896, p. 515.
" " Fowler, Rep't Cal. Agr'l Exp. Sta., 1902, Part II, p. 317.
" *improbus* Howard, Insect Book, 1904, Plate II, fig. 13, ♂.

Types.—Queen in the collection of the American Entomological Society. The male figured in Dr. L. O. Howard's "Insect Book" as *B. improbus* was used, with others, in making the description given below, and this specimen must be considered as the type of this sex. The male and the worker cotypes (here described for the first time) are all in the collection of the United States National Museum.

Pile short and rather coarse. Head of females, except occiput, and thorax of same sex, except anterior part of dorsum, black; abdomen variable, but always with second dorsal segment for the most part covered with yellow pile. Wings of females very dark and their legs black; malar space rather short.

Queen. Head.—Symmetrical trapezium-shaped; face and sides entirely black; triangular patch of pile on occiput with apical (anterior) part black and basal (posterior) part pure yellow, sometimes with a slight admixture of black hairs. Labrum with tubercle-like areas sharply and rather deeply concaved at the summit, the concaved surfaces rather smooth, but very sparsely punctate; median shelf-like projection of good width and rather prominent; translucent areas visible to the naked eye. Malar space about as long as its width at the apex, less than one-fourth as long as the eye. Clypeus sparsely punctate, smooth and shining. Ocelli typical and typically placed for *Bombias*. Flagellum of antennæ about twice as long as the scape; third antennal segment about equal to the fourth and fifth taken together, the fifth longer than the fourth.

Thorax.—Entirely black, except the anterior part of dorsum back to the tegulæ yellow; the yellow extending down on the sides, in front of the tegulæ, to somewhat below the level of the bases of the wings; disc naked and shining.

Abdomen.—Dorsum: segment one black; segment two, except basal middle, covered with yellow pile; segments three and four black; five and six covered with ferruginous pile of varying shade. Venter entirely black, except apical segment, this often bearing a sprinkling of ferruginous hairs. Hypopygium without median carina.

Wings.—Dark brown, the fore pair especially dark. Fore wings lightest in the region beyond the veins, darkest in the median and submedian cells and in the anterior portion of the second discoidal and about the tip of the radial cell; with very slight violaceous reflections.

Legs.—Coxæ, trochanters, femora, anterior and middle tibiæ and corbicular fringes all black; posterior metatarsi bearing no very long hairs.

Worker.—Much like the queen, but the wings usually considerably lighter and the triangular patch of pile on the occiput often entirely yellow; the scutellum sometimes with a strong admixture of yellow hairs; sides of first abdominal segment often with some yellow pile.

Male. Head.—Very broadly rounded, trapeziform. Face pretty well covered with nearly pure yellow pile, sometimes with a few black hairs intermixed, this pile almost touching the inner margin of the eye on either side; occiput covered with pure yellow pile; sides of head, behind eyes, bearing yellow pile for most part. Malar space about half as long as its width at apex; clypeus for most part covered up with pile; ocelli placed more than one-third of the distance from the supra-

orbital line toward the bases of the antennæ, the lateral ones not more than half their diameter from the inner margins of the eyes; eyes greatly swollen and often peculiarly pinkish in color; the vertex above the ocelli very slightly narrower than at the ocelli. Flagellum of antennæ fully three times as long as scape; third and fifth antennal segments subequal in length, fourth much shorter than either.

Thorax.—Anterior part of dorsum and the scutellum entirely covered with yellow pile, with a broad, but usually poorly defined (there being often a strong admixture of yellow hairs on the sides) black interalar band between. Mesopleura variable, sometimes covered with yellow to bases of legs and sometimes yellow for only a short distance below the level of the bases of the wings as in the females; metapleura and sides of median segment all black.

Abdomen.—Dorsum: first two segments covered with yellow pile; third segment sometimes entirely black, sometimes with considerable yellow on the sides; fourth segment entirely black, partly black and partly ferruginous (of varying shade), or entirely ferruginous; fifth segment variable in the same way and with the same colors as the fourth; sixth and seventh segments entirely covered with ferruginous (of varying shade) pile. Venter clothed with black pile, the two apical segments sometimes with some light ferruginous hair.

Genitalia.—Outer spatha (fig. 117) very broad, about one-fourth as long, from anterior to posterior border along the middle line, as wide, between extreme side margins; anterior lateral projections rounded; anterior border broadly and evenly incurved; posterior border broadly and evenly outcurved; posterior half of ventral surface covered with scattered hairs, somewhat thicker and longer on the sides than on the middle. Inner spatha (fig. 130) with median portion of anterior border broad and thickly chitinized and side portions curved strongly backwards; posterior part of ventral surface covered with moderately long hairs, with a very small, somewhat elongated median fenestra some distance from the posterior border, encircled by an elongated tuft of hairs. Claspers (figs. 81 and 88) rather thick and powerful in appearance, but somewhat suddenly more slender toward the apex. Branches broad at base, but narrowing rapidly toward the apex, their apices narrow and rounded as seen from dorsal side. Volsellæ very broad to about the ends of the branches, from there tapering rapidly; apical projections with outcurved and serrate margins. Squamæ deeply and acutely emarginate on inner side, the outer lobe being more than twice as large as the inner one and rather acutely rounded at apex; membrane rather large and noticeable. Heads of sagittæ irregularly sickle-shaped, the base of the sickle being very broad, the apex sharply pointed, and the outer border more or less serrate and forward bent. Uncus very broad, its strongly recurved portion tapering rapidly to a rather narrow and emarginate apex.

Wings.—Somewhat lighter as a rule than those of workers; quite strongly stained with brown.

Legs.—Coxæ, trochanters and fore femora usually entirely black, sometimes the two former with a slight sprinkling of yellow hairs; middle and hind femora usually entirely black, except for a small amount of yellow pile often present near their apices on the outer side; fore and middle tibiæ usually entirely black, but sometimes with a little ferruginous pile on their hind sides near the tip; fringes of hind tibiæ usually black, but sometimes rather strongly ferruginous. Outer faces of hind tibiæ convex and bare; fore fringes short; hind fringes only moderately long. Posterior metatarsi from three and one-half to four times as long as their greatest width, with hairs fringing hind borders long.

Dimensions.—Length: queen, 17 mm. to 21 mm.; worker, 11 mm. to 16 mm.; male, 14 mm. to 20 mm. Spread of wings: queen, 44 mm. to 50 mm.; worker, 28 mm. to 35 mm.; male, 36 mm. to 40 mm. Width of abdomen at second segment: queen, 10½ mm. to 12½ mm.; worker, 6½ mm. to 8 mm.; male, 7½ mm. to 8½ mm.

Redescribed from five queens (one of them a homotype), two workers and six males.

Variations.—The above described queen and worker are the typical forms of this species, but the abdomen is quite variable, and the following variations, between which I have seen every conceivable gradation, seem distinct enough to be worthy of description:

Color Variant 1.—Like the typical queen and worker, but with all the abdominal segments beyond the second entirely black. (Three queens and one worker.)

Color Variant 2.—The typical queen and worker, described above.

Color Variant 3.—Like the typical queen and worker, but with the three apical dorsal abdominal segments entirely covered with ferruginous pile. (Two queens and five workers.)

Color Variant 4.—Like Color Variant 3, but with the four apical dorsal segments covered with ferruginous pile. (Two queens.)

Habitat.—I have records of this species from southern California only, as follows: Tulare County, Ventura County, Los Angeles County, San Bernardino County, San Jose, Ontario, Claremont and San Diego. This shows that the species is confined pretty closely to the Upper and Lower Austral Zones and mainly to the latter. Probably it is to be found in some abundance in Lower California. Is it

present in southern Nevada, northern and southwestern Arizona, or western Mexico proper? While not especially rare in southern California, it does not appear to be very common there.

B. haueri Ant. Handlirsch is apparently the most closely related to this species of all those known to me, but the two can readily be separated by the coloration of the scutellum and first abdominal segment. Next to *haueri*, *B. morrisoni* Cress. appears to be the closest ally of *crotchii*.

I have examined the type specimen of Provancher's *B. nigrocinctus*. It is in the collection of the United States National Museum.

Bombus (Bombias) rufocinctus Cress.

Bombus rufocinctus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 106, n. 38, ☿ ♂.
" *ternarius* Putnam, Proc. Essex Inst., IV, 1863, p. 99 (pars.).
" " Packard, Proc. Essex Inst., IV, 1864, p. 117.
" *edwardsii* Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 184, ♀ (not the ☿ and ♂).
" " Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.) (pars.).
" *rufocinctus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 231 (Catal.).
" *edwardsii* Cresson, Syn. Hym. No. Amer., 1887, p. 308 (Catal.) (pars.).
" *rufocinctus* Cresson, Syn. Hym. No. Amer., 1887, p. 308 (Catal.).
" *edwardsii* Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 244.
" *praticola* Provancher, Addit. Faun. Can. Hym., 1888, p. 341, n. 10, ☿ (not the ♂).
? " *rufocinctus* Provancher, Addit. Faun. Can. Hym., 1888, p. 341, n. 12, ♀ ☿.
" *edwardsii* Dalla Torre, Cat. Hym., X, 1896, p. 518 (pars.) (Catal.).
" *rufocinctus* Dalla Torre, Cat. Hym., X, 1896, 545 (Catal.).
" *iridis* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 390.
" *rufocinctus* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 391 (pars.).
" *prunellæ* Cockerell and Porter, Ann. and Magaz. Nat. Hist., Ser. 7, IV, 1899, p. 391 (pars.).

? *Bombus ternarius* Cockerell, Entomologist, XXXII, June, 1899, p. 156.
" *edwardsii* Titus, Can. Ent., XXXIV, 1902, pp. 38 and 41, ♀.
" *rufocinctus* Titus, Can. Ent., XXXIV, 1902, pp. 39 and 43, ♀ ♂.
" *iridis* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *rufocinctus* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *prunellæ* Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" *vancouverensis* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 99.
" *edwardsii* Viereck, Can. Ent., XXXVI, April, 1904, pp. 98 and 100.
" *vancouverensis* Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p. 89.
" *prunellæ* Cockerell, Bull. So. Cal. Acad. Sci., III, June, 1904, p, 89 (pars.).
" *edwardsii* Kellogg, American Insects, 1905, p. 519.
" *iridis phaceliæ* Cockerell, Can. Ent., XXXVIII, May, 1906, p. 160.
" *prunellæ* Cockerell, Trans. Amer. Ent. Soc., XXXII, July, 1906, p. 238 (pars.).
" *rufocinctus* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *prunellæ* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313 (pars.).
" *iridis* Cockerell, Trans. Amer. Ent. Soc., XXXII, Nov., 1906, p. 313.
" *edwardsii* Cockerell, Trans. Amer. Ent. Soc. XXXII, Nov., 1906, p. 313.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Art. XXV, Dec. 17, 1906, p. 453, n. 112.
Bombias rufocinctus Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 6.
" *edwardsii* Swenk, Ent. News, XVIII, July, 1907, p. 295, n. 7.
" *rufocinctus astragali* Cockerell, The Entomologist, XL, 1907, p. 97, ♀.
" " *iridis* Cockerell, The Entomologist, XL, 1907, p. 97, ♀.
Bombus rufocinctus Cockerell, Univ. Colo. Studies, IV, 1907, p. 257.
" " var. *phaceliæ* Cockerell, ibid., p. 257.
" " var. *iridis* Cockerell, ibid., pp. 257 and 258.
" " var. *astragali* Cockerell, ibid., pp. 257 and 258.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111.

Bombus hyperboreus var. *Albertensis* Cockerell, Can. Ent., XLI, Jan., 1909, p. 36.

" *rufocinctus phaceliæ* Cockerell, Can. Ent., XLII, 1910, p. 25.

" " *astragali* Cockerell, Can. Ent., XLII, 1910, p. 25.

Types.—In the collection of the American Entomological Society.

Pile short; malar space short; face usually dark; occiput yellow; legs of females dark; wings not very dark; color characters extremely variable—abdomen ferruginous and yellow, black and yellow, or black, ferruginous and yellow; dorsum of thorax mostly yellow, but at least the disc dark.

Queen. Head.—Broadly rounded trapeziform; face mostly black, but with a sprinkling of light pile between and above the bases of the antennæ (not very noticeable, in most cases, except with the aid of a lens); occiput yellow, but often with a more or less strong admixture of dark hairs; sides of head black. Labrum with tubercle-like areas well separated and with rounded margins and flat summits; shelf-like projection rather small and narrow; translucent areas faintly visible to the naked eye. Malar space considerably shorter than its width at the apex, not more than one-sixth as long as the eye. Clypeus rather sparsely and delicately punctate. Ocelli not far below the supra-orbital line, slightly above the narrowest part of the vertex. Flagellum of antennæ about one and two-thirds times as long as scape; third antennal segment equal to the fourth and fifth taken together, the fifth scarcely longer than the fourth.

Thorax.—Dorsum sometimes with only the disc black and sometimes with a black interalar band, the remainder being covered with yellow pile; center of disc naked, smooth and shining. Mesopleura usually covered for the most part with yellow pile, often entirely so to the bases of the legs, but as often with the very lowest parts black, and occasionally as much as the entire lower halves dark. Metapleura and sides of median segment sometimes entirely dark, sometimes with mixed yellow and black pile and sometimes with yellow pile only.

Abdomen.—Dorsum: segment one yellow; segment two with basal middle yellow, the rest black; segment three black; segment four with basal portion black and apical portion covered with yellow pile; segment five with considerable yellow pile on the sides, but black in the middle; segment six black. Venter mostly black, but often with a considerable sprinkling of light hairs on the apical margins of some of the segments, especially toward the sides. Epipygium with a low, rounded, longitudinal, median carina on its apical portion. Hypopygium tending to be carinate on apical portion.

Wings.—Not very deeply stained with brown; the fore pair generally lighter across the middle portion.

Legs.—Usually all dark, but the trochanters and bases of femora often with some light pile on their lower sides.

Worker.—Much like the queen, but with lighter (subhyaline) wings; a black interalar band usually present; mesopleura usually entirely covered with yellow pile; metapleura and sides of median segment usually with little other than light or yellow pile; venter tending to have rather more light pile on apical portion than in case of queen.

Male. *Head*.—Broadly rounded trapeziform. Face with a patch of usually strongly yellow pile running from the bases of the antennæ down over the clypeus, sometimes, however, with a strong admixture of dark hairs; above the bases of the antennæ sometimes black and sometimes with a tuft of yellow hair. Occiput yellow; sides of head behind the eyes sometimes entirely dark, but usually with more or less yellow pile connecting with the yellow on the occiput. Malar space not more than half as long as its width at apex. Clypeus usually mostly covered up with pile. Eyes somewhat swollen and bulging out from sides of head. Ocelli placed at not more than one-fourth of the distance from the supra-orbital line toward the bases of the antennæ. Each lateral ocellus separated from the margin of the eye by about its own diameter. Flagellum of antennæ a little less than three times as long as the scape; third antennal segment about equal to the fifth, the fourth shorter than either.

Thorax.—Front part of dorsum and scutellum covered with yellow pile. A broad black interalar band usually present but often partly or entirely obliterated, the whole dorsum then being yellow. Mesopleura covered with yellow pile to the bases of the legs. Metapleura and sides of median segment with mostly yellow pile, but often with some dark hair.

Abdomen.—Dorsum: segments one and two covered with yellow pile; segments three and four covered with ferruginous pile; segments five, six and seven yellow, but often with an admixture of black or ferruginous hairs. Venter very variable, sometimes mostly black and sometimes with mostly light pile, but always with the apical margins of the segments fringed more or less with light hairs.

Genitalia.—Outer spatha (fig. 122) short and broad; the anterior margin deeply incurved; anterior lateral projections rounded at their ends; side margins nearly straight; posterior margin broadly, but not deeply, incurved in the middle; apical portion of ventral surface scattered over with hairs, these being longest on the sides. Inner spatha (fig. 55) with anterior margin, except median projection, straight; the lateral margins converging sharply toward each other; apex narrow and rounded and bearing rather dense hair on its ventral surface; a single median fenestra of varying shape usually present. Claspers (figs. 79 and 84) with branches rather narrow toward the tip and rounded at the end as viewed from dorsal side; volsellæ of nearly even width throughout, but narrowing near their ends to pointed tips

and extending far beyond the tips of the squamæ; squamæ with the two lobes pointed and nearly equal. Sagittæ with shafts bent outward somewhat in the middle and heads very irregularly sickle-shaped, the tips appearing narrow and pointed. Uncus very broad at base and tapering somewhat rapidly to its rounded tip.

Wings.—About like those of the workers.

Legs.—Coxæ sometimes entirely black, but usually with some yellow hair; trochanters with more or less yellow pile on their lower sides; femora with considerable yellow hair; fore and middle tibiæ black; posterior tibiæ with outer faces convex, naked and shining, with front fringes short and black and hind fringes long and sometimes entirely black, but often more or less strongly ferruginous. Posterior metatarsi about two and one-half times as long as their greatest width; with moderately long hind fringes, sometimes black and sometimes more or less ferruginous; their outer faces concave and rather sparsely pubescent.

Dimensions.—Length: queen, 14 mm. to 16 mm.; worker, 8 mm. to 13 mm.; male, 10 mm. to 15 mm. Spread of wings: queen, 31 mm. to 36 mm.; worker, 18 mm. to 31 mm.; male, 22 mm. to 31 mm. Width of abdomen at second segment: queen, 8 mm. to 8½ mm.; worker, 4 mm. to 7 mm.; male, 5½ mm. to 7 mm.

Redescribed from fifteen queens (one of them a homotype of the *edwardsii* ♀ of Cresson), ten workers and seven males.

Variations.—This species is the most variable in coloration of any in the Western Hemispere. I here describe such forms as seem marked distinctly enough to deserve description. Between these various forms (which I have chosen to call Color Variants), I have seen almost every conceivable gradation both in the males and in the females. I have also examined the genitalia of the variously colored males and find them to agree perfectly in every case.

Color Variant 1 (var. *albertensis* Ckll.).—Queen and worker like the typical form, but with abdomen entirely black except for the first and basal middle of the second dorsal segments which are yellow. Three queens and two workers from Montana (Bozeman and Gallatin County—elevation about 5000 feet), one queen from Alberta (Calgary) and one worker from the old territory of Assiniboia (Regina).

Color Variant 2.—The typical form of queen and worker described above. Many specimens from Montana, Colorado and New Mexico.

Color Variant 3.—Queen and worker like the typical form, but with the apical portion of the third dorsal abdominal segment more or less ferruginous and the fourth dorsal segment entirely yellow. Several

specimens, one of them a cotype of *iridis* Ckll., from Montana and New Mexico.

Color Variant 4.—Queen and worker like Color Variant 3, but with the second dorsal abdominal segment, except the yellow basal middle, and the third dorsal segment entirely covered with ferruginous pile. Many specimens from Montana, Colorado and New Mexico.

Color Variant 5.—Queen like that of Color Variant 4, but with the first dorsal abdominal segment and the basal middle of the second also entirely ferruginous, thus making the three basal dorsal abdominal segments entirely ferruginous. Two specimens from Montana.

Color Variant 6.—(Most of the workers of Putnam's "Bridport, Vermont," nest and many queens and workers from Ottawa, Wisconsin and Montana). Queen and worker like those of Color Variant 4, but with the fourth dorsal abdominal segment entirely ferruginous, and the fifth entirely black or with touches of ferruginous on the sides. (Some of the workers of the Bridport nest have the fifth segment with more or less yellow pile, and the queen has the apical part of the fourth segment with some yellow pile).

Color Variant 7.—(*B. prunellæ* Ckll.). Queen and worker like the typical form, but with face bearing a more or less noticeable amount of yellow pile, pleura yellow to bases of legs, second dorsal abdominal segment entirely covered with yellow, fifth segment entirely yellow and hind trochanters and femora bearing considerable yellow pile. Many specimens, from Colorado and New Mexico.

Male Color Variant 1.—Like the typical form described above, but with the fourth dorsal abdominal segment yellow instead of ferruginous. Many specimens, from Montana, Ottawa and New Mexico.

Male Color Variant 2.—Like the typical form, but with the seventh dorsal abdominal segment entirely clothed with ferruginous pile. Several specimens from Montana.

Male Color Variant 3.—The typical form described above. Several specimens from Montana and Kansas.

Male Color Variant 4.—Like the typical form, but with all the dorsal abdominal segments after the first two entirely covered with ferruginous pile. Many specimens, from Ottawa, Montana and Colorado.

Male Color Variant 5.—Like the typical form, but with the dorsum of the abdomen mostly yellow, sometimes with slight touches of black or ferruginous on the apical half. Many specimens, from Arizona, Washington, Montana and New York.

Male Color Variant 6.—Like the typical form, but with all the dorsal abdominal segments after the first two entirely black. A few specimens from Montana and New York.

Male Color Variant 7.—Like the typical form, but with the fourth dorsal abdominal segment yellow, and the fifth, sixth and seventh light ferruginous. A single specimen from Fort MacLeod, British Columbia.

Male Color Variant 8.—Like Male Color Variant 1, but with the third dorsal abdominal segment black instead of ferruginous, and the pile on the apical dorsal segments more whitish. A few specimens, from Arizona, California and Montana.

Male Color Variant 9.—Like Male Color Variant 8, but with the fourth and seventh dorsal abdominal segments black. A few specimens from Montana.

Habitat.—I have records of this species from different parts of the United States as follows: Washington, Oregon, California, Nevada, Arizona, Utah, Montana, Wyoming, Colorado, New Mexico, Kansas, Nebraska, South Dakota, Minnesota (one ♂ collected at St. Paul), Wisconsin, Michigan, New York, Vermont (Bridport) and a doubtful one from Tennessee. I also have the following records from Canada: Quebec, Ontario, Manitoba, the old territory of Saskatchewan (Radisson), Alberta (Calgary), the old territory of Assiniboia (Regina) and British Columbia. My most southern records are Mescalero, New Mexico and southern Arizona. What are its northern limits, also its southern limits in the East and in the West? It is a rare species in the eastern part of its range, and appears to reach its maximum abundance in the Rocky Mountain region of the northwestern United States, where it is common. It may range down the Appalachian Mountain system, but this is exceedingly doubtful, as I have only the single Tennessee record south of New York. Does it range through northern New England and New Brunswick? It belongs mainly to the Canadian and Transition Zones, but runs over somewhat into the Upper Austral.

Nests.—One of the nests taken at Bridport, Vt., by F. W. Putnam and considered by him and by Dr. Packard as that of *B. ternarius* was really a nest of this species. It contained one queen and twenty-four workers, instead of twenty-three specimens as stated by Dr. Packard. These specimens have been all kept together in the collection of the Museum of Comparative Zoölogy at Cambridge. This is apparently the nest, with three specimens lacking, which Putnam (cf. Proc. Essex Inst., IV, p. 99) refers to as having been found "under the clapboards of a house," as the true *ternarius* Say

nest, taken by him and in the same collection, contains only a few specimens. There is a specimen from Ottawa before me, however, which was taken eight inches under ground, and this leads me to believe that the species, sometimes at least, makes nests under ground.

That the females and males above described should go together, I have the following proofs:

1. Similarity of appearance.—These females and males resemble each other quite strongly, much more so than they either resemble other males or females respectively.

2. Corresponding variation.—These females and males both run through a wide range of color variation, and the range of variation of the males is, in general, very similar to that of the females.

3. Coördination of structure.—The location of the ocelli of the females and the location of the ocelli and form of the eyes of the males are all transitional *Bombias* in character.

4. Concordance of habitat.—The females and males both have the same range of habitat, and they are taken in corresponding numbers in different parts of that range.

Prof. Cockerell has kindly loaned me a cotype of *iridis*, and it is a form of *rufocinctus* beyond doubt. Prof. Cockerell's description of *B. prunellæ* was based upon specimens of two distinct and not at all closely allied species. Some of the cotypes evidently belong to a valid new form of the *Pratorum* group, and I am, in this paper, calling this form *B. cockerelli*. The specimen of *prunellæ* in the United States National Museum, marked distinctly as the type and further labelled "White Mts., N. Mex., Rio Ruidoso, about 7600 ft. alt.," together with some of the cotypes deposited in the collection of the American Entomological Society, represent, beyond a doubt, a subspecies of *rufocinctus*, as above noted. As the name of a species must go with the type specimen, where such is indicated, I have placed *prunellæ* in the synonomy of *rufocinctus*.

With the exception of *mexicensis* and of *henshawi*, *rufocinctus* seems to have no very close allies in North America; on the basis of the structure of the genitalia, *B. crotchii* seems to come next nearest.

The yellow pile of this species varies considerably in

shade. In some specimens it is very pale straw yellow, while in others it is light golden. The ferruginous pile also varies greatly in shade, in many specimens being quite pale while in some it is almost wine color.

Bombus (Bombias) henshawi new species.

Types.—Described from two queens (cotypes) from San Francisco and Palo Alto, California, one of which is deposited in the collection of the Museum of Comparative Zoölogy at Cambridge and the other in the collection of Leland Stanford Jr. University.

Pile of medium length and texture. Face dark; occiput with yellow pile; dorsum of thorax entirely covered with yellow pile, except for a black band between the bases of the wings; pleura mostly dark; abdomen dark, except for the fourth and fifth dorsal segments bearing yellow pile; legs dark; wings not very deeply stained with brown. Malar space short.

Queen. Head.—Face entirely dark; occiput with a triangular patch of yellow pile; cheeks dark. Labrum with tubercle-like areas having their margins rounded and summits flat or slightly concave; shelf-like projection wide and prominent. Malar space distinctly shorter than its width at apex, about one-sixth as long as the eye. Clypeus rather sparsely and delicately punctate over the disc. Ocelli not much below the supra-orbital line. Flagellum of antenna about one and two-thirds times as long as the scape; third antennal segment much longer than the fifth, almost equal to the fourth and fifth taken together, the fifth somewhat longer than the fourth.

Thorax.—Dorsum, except for a well defined black interalar band, entirely covered with light yellow pile; the yellow on the anterior part extending down onto the sides to somewhat below the level of the bases of the wings. The center of the disc bare and smooth. The mesopleura mostly, and the metapleura and sides of the median segment entirely, dark.

Abdomen.—Dorsum: first three segments entirely covered with black pile; fourth segment covered with yellow pile; fifth segment mostly covered with yellow pile, but with a small amount of black hair in the middle; sixth segment dark. Venter dark. Hypopygium with a median carina on its apical portion.

Wings.—Not very deeply stained with brown; the fore pair lightest in the region beyond the veins.

Legs.—Coxæ, trochanters, femora and tibiæ, including corbicular fringes, dark.

Dimensions.—Length, 15 mm.; spread of wings, 35 mm.; width of abdomen at second segment, about $8\frac{1}{2}$ mm.

This species is very closely allied to *B. rufocinctus* Cress., and it is possible that extensive collecting will show that it should be considered either a subspecies or a color variant of that species.

I take pleasure in naming this species for Mr. Samuel Henshaw, Curator of the Museum of Comparative Zoölogy, who loaned me one of the specimens.

Genus **PSITHYRUS** Lepeletier.

Apis (ex parte) Fabricius, Ent. Syst., II, 1793, p. 317, and other old authors.
Apis * * e, 2, Kirby, Monog. Ap. Angl., I, 1802, p. 209.
Bombus (ex parte) Fabricius, Syst. Piez., 1804, p. 342, and other old authors.
Bremus (ex parte) Panzer, Faun. Insect. German., VIII, 1805.
Uneigentliche Hummeln Illiger, Magaz. für Insektenk., V, 1806, p. 173.
Bremus (ex parte) Jurine, Nouv. Méth. Class. Hymén., 1807, p. 257.
Bombus, Divisio secunda, Dahlb. Bomb. Scand., 1832, p. 30.
Psithyrus Lepeletier, Ann. Soc. Ent. France, I, 1832, p. 372.
Apathus Newman, Ent. Magaz., II, 1834, p. 404, nota.
Psithyrus Lepeletier, Hist. Nat. Insect, I, 1836, pp. 33 and 458.
" Westwood, Int. Mod. Class. Insect., II, 1840, p. 280.
" Lepeletier, Hist. Nat. Insect., II, 1841, p. 424.
Apathus Smith, Cat. Bees of Great Britain, 1855, p. 234.
Bombus (ex parte) Greene, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, p. 169.
Apathus Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 110.
" Packard, Proc. Essex Instit., IV, 1864, p. 118.
" Thomson, Opusc. Ent., I, 1869, pp. 7 and 12.
Psithyrus Schmiedeknecht, Apidæ Europaeæ, I, 1882–84, pp. 385 to 391.
Apathus Provancher, Faun. Ent. Can., II, 1883, pp. 728 and 736.
Psithyrus Dalla Torre, Cat. Hym., X, 1896, p. 565.
" Sharp, Insects, II, 1899, p. 59.
" Ashmead, Trans. Amer. Ent. Soc., XXVI, 1899, p. 58.
" Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 176.
" Schmiedeknecht, Hym. Mitteleurop., 1907, p. 24.

Type of genus.—*Psithyrus rupestris* (F.), the first species placed under the genus by Lepeletier.

Common names.—The bees of this genus are, in common with those of *Bombus*, popularly known as "Humble-bees"

or "Bumble-bees," for only entomologists recognize the differences between the two genera. In entomological literature, the species of *Psithyrus* have been called "Guest Bees," "Inquiline Bees" and "Guest Bumble-bees." They have been given these names because of the fact that the published observations, concerning their life history and habits, indicate that they are habitually inquilinous in the nests of species of *Bombus*. Many of the European records concerning this are evidently valid, but there is not yet a single true New World account of a *Psithyrus* having been found in a *Bombus* nest. As there are other bees which are inquilinous in the nests of solitary bees, the terms "Guest Bees" and "Inquiline Bees" cannot be distinctive names for *Psithyrus* species. The name "Guest Bumble-bees" is distinctive and appropriate as these insects have undoubtedly descended with *Bombus* from a common ancestral stock.

Degeneracy.—Most of the structural characters, in which *Psithyrus* differs from *Bombus*, appear to show a more or less marked degeneration. Among these marks of degeneracy, the following may be particularly mentioned:

1. The absence of corbiculæ, which is correlated with their having given up the habit of gathering pollen.

2. The absence of the "pollen mills," which is also apparently correlated with their loss of the pollen collecting habit. These structures and the corbiculæ are present in *Apis* as well as in *Bombus*, and are very much alike in those two genera.

3. The comparatively small eyes, apparently correlated with their habit of spending so much of their time in loafing in the darkness of the nests of their hosts instead of flying actively abroad.

4. The general form and the untoothed condition of the mandibles of the females are probably primitive and they may be degenerate also. They are much like those of the honey-bee, but the honey-bee does not build a nest of grass or similar coarse materal, and so does not need mandibles so well developed for tearing and cutting.

5. The narrower hind metatarsi. They are very broad in *Apis* as well as in *Bombus*.

6. The membraneous volsellæ of the male genitalia, with apical projections absent, apparently correlated with a somewhat different method of copulation. The lateral elevations on the female hypopygium perhaps have some significance in this connection.

Distinctive Characters of the Genus.

Female with mandibles entire or with a single notch, the lower side of their apical margin protruding much more strongly than in *Bombus* (figs. 46 and 49); labrum triangular in outline(fig. 103); abdomen, over a large part of the dorsal surface, rather scantily clothed with pile, giving it a shiny appearance; tip of abdomen usually bent noticeably downward and forward; apical segment of venter with prominent lateral elevations (fig. H); posterior tibiæ with outer surface convex and well covered with hair (never anything more than a trace of corbicula present) (fig. A); inner side of end of posterior tibia without a row of stout spines (fig. 48); posterior metatarsi without a prominent projection at the base on the posterior side (fig. I), and drawn out into a somewhat more prominent projection at the apex, behind the insertion of the second tarsal segment, than in *Bombus*.

Male with volsellæ and squamæ of genitalia membraneous, the volsellæ long, extending far beyond the tips of the squamæ, and without apical projections; anterior margin of labrum outcurved (fig. 57); hind metatarsi with at least moderately long hind fringes, their outer faces somewhat concaved and usually strongly and rather evenly pubescent; outer faces of hind tibiæ convex and hairy, the fore and hind fringes always of good length.

This genus, as represented in the New World, is divided into the three following distinct and separate groups: *Laboriosus*, *Ashtoni* and *Fernaldæ*. These groups are all newly established in this paper, and each one bears the name of its typical species.

Tables of the North American Species of the Genus Psithyrus

FEMALES.

1. Occiput black, with little or no light or yellow pile..... 2.
   Occiput bearing a considerable amount of light or yellow pile... 3.
2. Pleura bearing light or yellow pile to bases of legs....**latitarsus.**
   Lower portion of pleura covered with dark brown or black pile.
   ashtoni.

3. Pleura with lower portion dark brown or black..... 4.
   Pleura bearing light or yellow pile to, or very nearly to, bases of legs..... 6.
4. Scutellum with a large amount of yellow pile..... 5.
   Scutellum black .....**crawfordi.**
5. Abdomen with some dorsal segments bearing considerable yellow pile on the sides.....10.
   Abdomen with no segment bearing yellow pile.....**variabilis.**
6. Area between ocelli and bases of antennæ with a considerable amount of yellow pile..... 7.
   This area with little or no yellow pile..... 8.
7. Abdomen entirely black.....**intrudens.**
   Abdomen with considerable yellow pile on some segments. **insularis.**
8. Fourth dorsal abdominal segment with much yellow pile..... 9.
   Fourth segment with little or no yellow pile.....**laboriosus.**
9. Apical abdominal segment very pointed and very strongly recurved ; the tip of the hypopygium extending considerably beyond the tip of the epipygium ; the fifth dorsal abdominal segment often with considerable ferruginous pile on the sides. **fernaldæ.**
   Apical abdominal segment moderately pointed and moderately recurved ; the tip of the hypopygium extending but little beyond the tip of the epipygium ; the fifth dorsal segment never with ferruginous pile.....**insularis.**
10. Apical abdominal segment extremely pointed and very strongy recurved ; the tip of the hypopygium extending considerably beyond the tip of the epipygium ; the fifth dorsal abdominal segment often with considerable ferruginous pile on the sides. **fernaldæ.**
    Apical segment moderately pointed and moderately recurved ; the tip of the hypopygium extending but little beyond the tip of the epipygium ; the fifth dorsal segment never with ferruginous pile.....**bicolor.**

MALES.

1. Anal segment of abdomen with a large amount of ferruginous pile on dorsum .....**tricolor.**
   Anal dorsal segment black or yellow..... 2.
2. Pleura covered with yellow pile to the bases of the legs..... 3.
   Lower portion of pleura covered with dark brown or black pile.. 4.
3. Fourth dorsal abdominal segment covered with entirely black pile. **laboriosus.**
   Fourth dorsal segment either on the sides or entirely covered with yellow pile..... 5.

4. First dorsal abdominal segment mostly covered with yellow pile. **ashtoni.**
   First segment entirely dark ..... 6.
5. Third and fifth antennal segments subequal in length ...**suckleyi.**
   Fifth antennal segment nearly equalling the length of the third and fourth together.....**consultus.**
6. Scutellum entirely dark.....**crawfordi.**
   Scutellum with much yellow pile.....**variabilis.**

THE LABORIOSUS GROUP.

Characters of the Group.

Female.—Occiput with a triangular patch of yellow pile. Malar space medium. Hind metatarsi about three times as long as their greatest width. Lateral elevations of hypopygium moderate, their anterior portions being more or less rounded and higher than their ridge-like posterior portions.

Male.—Flagellum of antenna distinctly more than three times as long as the scape; the fifth antennal segment distinctly longer than the third. Clasper of genitalia (figs. 93, 94 and 97) with squama strongly and broadly bilobed, both lobes being somewhat pointed toward their tips. Shaft of sagitta with a prominent tooth-like projection on its ventral side, somewhat beyond the middle.

Psithyrus laboriosus F.

? *Apis alata* Fabricius, Suppl. Entom. Syst., 1798, p. 274, no. 43–44.
Bombus laboriosus Fabr. Syst. Piez., 1804, p. 352, n. 51.
? *Bombus elatus* Fabricius, Syst. Piez., 1804, p. 352,n . 49.
? " " Illiger, Magaz. f. Insektenk., V, 1806, p. 171, no. 41.
? " " Illiger, Magaz. f. Insektenk., V, 1806, p. 174, n. 62.
Apathus citrinus Smith, Catal. Hymen. Brit. Mus., II, 1854, p. 385, n. 7, ♂.
" *laboriosus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 111, n. 1, ♀.
" *contiguus* Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 112, n. 4, ♂.
" *citrinus* Cresson, Proc. Ent, Soc. Phila., II, 1863, p. 112, n. 5, ♂.
" " Walsh, Proc. Ent. Soc. Phila., III, 1864, p. 247, ♂.
" *laboriosus* Walsh, Proc. Ent. Soc. Phila., III, 1864, p. 247, ♀.
" *citrinus* Packard, Proc. Essex Instit., IV, 1864, p. 119, ♂.
" *contiguus* Packard, Proc. Essex Instit., IV, 1864, p. 129, ♂.

Apathus " Cresson, Trans. Amer. Ent. Soc., IV, 1872, p. 284.
" *laboriosus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *citrinus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" " var. *contiguus* Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" *laboriosus* Provancher, Natural. Canad., XIII, 1882, p. 268, n. 1, ♀.
" *citrinus* Provancher, Natural. Canad., XIII, 1882, p. 269, n. 4, ♂.
" *laboriosus* Provancher, Faun. Ent. Can. Hym., 1883, p. 736, n. 1, ♀.
" *citrinus* Provancher, Faun. Ent. Can. Hym., 1883, p. 737, n. 4, ♂.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" " var. *contiguus* Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" *laboriosus* Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" " Provancher, Addit. Faun. Canad. Hymen., 1888, p. 342, ♀, and 343, ♂.
" *citrinus* Provancher, Addit. Faun. Canad. Hymen., 1888, p. 342, ♂.
Psithyrus citrinus Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 248; T. 10, F. 16.
" " Dalla Torre, Cat. Hym., X, 1896, p. 568 (Catal.).
" " var. *contiguus* Dalla Torre, Cat. Hym., X, 1896, p. 568.
" *laboriosus* Dalla Torre, Cat. Hym., X, 1896, p. 569 (Catal.).
" " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 178, ♂ and ♀.
" " Howard, Insect Book, I904, Plate II, fig. 22, ♀.
" *citrinus* Howard, Insect Book, 1904, Plate II, fig. 23, ♂.
" *laboriosus* Lovell, Ent. News, XVIII, May, 1907, pp. 199–200.
" " Swenk, Ent. News, XVIII, July, 1907, p. 297, n. 2.
" " Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907, p. 17.

Types.—Smith's type of *citrinus*, so Col. C. T. Bingham wrote me, is in the collection of the British Museum. At least a part of the specimens, on which Cresson based his description of *contiguus*, are in the collection of the American Entomological Society.

Female.—Face mostly dark; occiput with yellow pile; thoracic dorsum and pleura yellow; dorsum of abdomen black, but the third segment often with more or less yellow pile, and segments one, two and four sometimes with touches of yellow, especially on the sides; venter and legs dark; malar space rather long; hind metatarsi narrow for their length.

Male.—Face dark; occiput usually with much yellow pile; thorax yellow, with or without a black interalar band; dorsum of abdomen usually with the first two or three segments mostly or entirely covered with yellow pile, the remainder being black; venter and legs black.

Female. Head.—Face often with a faint touch of yellow above the bases of the antennæ, but as often entirely dark; occiput with a large triangular patch of pure yellow pile; cheeks dark. Apical margin of the mandibles sometimes entire, but usually with a notch in the middle. Malar space shorter than its width at the apex, about one-fourth as long as the eye. Clypeus with its anterior portion more or less sparsely punctate in the middle, the remainder being coarsely and densely punctate. Flagellum of antenna more than one and four-fifths times as long as the scape; third and fifth antennal segments subequal in length, the fourth distinctly shorter than either.

Thorax.—Dorsum covered with yellow pile, the very center of the disc being naked; mesopleura yellow to the bases of the legs; metapleura occasionally mostly dark, but usually clothed for the most part with yellow pile; sides of the median segment usually mostly dark, sometimes with a little yellow pile.

Abdomen.—Dorsum, segment one usually entirely dark, but often with a touch of yellow on each anterior corner; segment two usually entirely black, but occasionally with yellow pile on its apical margin; segment three often entirely black, but usually with more or less yellow pile, at least on the sides, and sometimes entirely covered with it; segment four usually entirely black, but occasionally with touches of yellow pile on the sides and a fringe of yellow along the basal margin; segment five black; segment six black, but with the apex bearing more or less brownish-ferruginous pubescence. Venter dark, but the apical portion of the last segment with considerable brownish-ferruginous pubescence. Hypopygium with lateral elevations much as in *insularis*.

Wings.—Moderately stained with brown; the fore pair usually darkest in the region beyond the veins.

Legs.—Dark; the hind metatarsi nearly three times as long as their greatest breadth, their hind margins being only slightly curved.

Male. Head.—Face black, sometimes with a very faint sprinkling of yellow hairs above the bases of the antennæ; occiput with a triangular patch of yellow pile, often with black hairs admixed; cheeks entirely dark. Malar space shorter than its width at the apex; between one-fifth and one-sixth as long as the eye. Clypeus covered with

black pile. Flagellum of antenna about three and one-half times as long as the scape; fifth antennal segment much longer than the third, the third longer than the fourth.

Thorax.—Dorsum entirely covered with yellow pile, or with a black spot on the disc, or with a distinct, though rather poorly defined, black band between the bases of the wings; the very center of the disc naked; mesopleura yellow to, or nearly to, the bases of the legs; metapleura sometimes largely covered with yellow pile and sometimes with very little; sides of the median segment usually dark.

Abdomen.—Dorsum: segment one yellow; segment two yellow, but often with a black spot on each side of the base, and rarely even only the basal middle with yellow pile; segment three entirely black (*contiguus* Cress.), entirely yellow (*citrinus* F. Sm.), or with part black and part yellow pile; segments four to seven inclusive black. Venter dark.

Genitalia.—Inner spatha very much like that of *variabilis* (fig 59), but often with its hind margin curved forward considerably in the middle so as to make the apex appear feebly bilobate. Outer spatha considerably like that of *ashtoni* (fig. 60), but considerably broader for its length and with more numerous hairs on its ventral surface. Claspers (fig. 94) with their branches broadly rounded at the end as viewed from dorsal side; squamæ broadly bilobate, the lobes being about equal in size and more or less pointed; the volsellæ widest at the middle and more or less pointed at their tips, the inner margin of each nearly straight from its tip to about its middle and in front of its middle rather suddenly incurved, the outer margin being gradually outcurved. Sagittæ much like those of *variabilis* (fig. 97).

Wings.—Much like those of the female.

Legs.—Entirely dark; the hind fringes of the hind metatarsi sometimes more or less ferruginous.

Dimensions.—Length: female, 14 mm. to 18 mm.; male, 11½ mm. to 15½ mm. Spread of wings: female, 33 mm. to 40 mm.; male, 28½ mm. to 36 mm. Width of abdomen at second segment: female, 7 mm. to 9 mm.; male, 5 mm. to 7½ mm.

Redescribed from many specimens of each sex.

Habitat.—I have records of this species as follows: Canada (Montreal, Ottawa, Prince Edward Island and Grand Manan Island), Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, North Carolina (Blowing Rock, Wilkesboro and Bushnell), Tennessee, Kentucky, Ohio, Michigan, Indiana, Illinois, Wisconsin and Minnesota (St. Paul and Lake Itasca). Swenk (Ent. News, July, 1907, p. 297) reports the species from Lincoln and West Point,

Nebraska. It is probably present in Iowa, South Dakota, North Dakota, Kansas, Missouri, northern Georgia and northwestern South Carolina, and it is possible that extensive collecting will extend its habitat even beyond these limits. It seems to be rather strictly confined to the Transition and Upper Austral Zones, being apparently most abundant in the eastern part of its range (Swenk reports the capture of only two specimens in Nebraska).

The females of this species are most closely allied to *insularis* and the males to *consultus*, as shown by their structure in each case.

I follow Walsh, Robertson and Lovell in considering *citrinus* F. Sm. and *contiguus* Cress. to be males of *laboriosus* F. I do not know of their having been taken in *coitu* or in the nests of *Bombus*. The evidences of their relationship are as follows:

1. *Similarity of appearance.*—These males resemble the females of *laboriosus* in coloration more closely than do any other male Psithyri of the New World, known to me.

2. *Concordance of habitat.*—These males have the same geographical range as the females of *laboriosus*, and are taken in corresponding abundance in the different parts of that range. No other males known to me come anywhere near fulfilling this requirement.

In my opinion, Fabricius' description of *Apis elata* fits the *citrinus* variation of the male of *laboriosus* better than any other form of either *Bombus* or *Psithyrus* in North America known to science.

Psithyrus insularis (F. Sm.).

‖ *Bombus interruptus* Greene, Ann. Lyc. Nat. Hist. New York, VII, 1858, p. 11, n. 1, ♀.
" " Greene, Ann. Lyc. Nat. Hist. New York, VII, 1860, p. 173, n. 11, ♀.
Apathus insularis Smith, Journ. of Ent., I, 1861, p. 155, n. 2, ♀.
" " Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 113, n. 6, ♀ (not the ♂).
" " Cresson, Proc. Davenp. Acad. Nat. Sci., I, 1876, p. 210.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).

Apathus insularis Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" " Provancher, Addit. Faun. Can. Hym., 1888, p. 343, n. 5, ♀.
Psithyrus " Ant. Handlirsch, Ann. Naturh. Hofmus. Wien., III, 1888, p. 248 (pars.).
" *interruptus* Dalla Torre, Cat. Hym., X, p. 569 (pars?), 1896.
" *insularis* Ashmead, Proc. Wash. Acad. Sci., IV, 1902 (May 29), p. 130 (pars.).
" " Ashmead, Hym. of Alaska, 1904, p. 136 (pars).
" " Swenk, Ent. News, XVIII, July, 1907, p. 297, n. 3.
" " Viereck, Can. Ent., XXXVI, p. 100, April, 1904.
" " Cockerell, Bull. Amer. Mus. Nat. Hist., XXII, Article XXV, Dec. 17, 1906, p. 453, n. 109.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, 1906, p. 312.
" " Viereck, Trans. Amer. Ent. Soc., XXIX, 1903, p. 45.
" " Viereck, Trans. Amer. Ent. Soc., XXXII, July, 1906, pp. 238, 240 and 242.
" " Morrill, Can. Ent., XXXV, 1903, p. 225 (with drawings showing structural characters).
" *interruptus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1907,p . 17.
? " *insularis* Cockerell, Can. Ent., XLII, 1910, p. 25.

Type.—The type female of this species, described as *Bombus interruptus* by Greene, is apparently lost. Smith's *insularis* is probaby in the collection of the British Museum, though Col. Bingham was unable to locate it for me.

Face usually with more or less yellow pile between and above the bases of the antennæ; occiput with much yellow pile; dorsum of thorax yellow, but with a black interalar band or at least the disc black; pleura mostly yellow to the bases of the legs; dorsum of abdomen black, with more or less yellow on the sides of the third, fourth and fifth segments, and sometimes a little on the hind corners of the second. Venter and legs dark. Malar space rather long. Hind metatarsi narrow for their length.

Female. Head.—Face usually with considerable yellow pile above, and usually with a distinct tuft of yellow between, the bases of the antennæ, but sometimes almost entirely dark; occiput with a large triangular patch of pure yellow pile; cheeks dark. Mandibles (fig. 46) sometimes with apical margin entire and sometimes with a notch in

its middle. Malar space shorter than its width at the apex, about one-fourth as long as the eye. Clypeus with its anterior portion sparsely punctate in the middle, the remainder being coarsely and densely punctate. Flagellum of antenna nearly one and four-fifths times as long as the scape; third and fifth antennal segments subequal in length, the fourth much shorter than either.

Thorax.—Dorsum yellow, usually with a distinct, though often poorly defined, black band between the bases of the wings; sometimes all yellow, except for a large black spot on the disc. Mesopleura covered with yellow pile to, or nearly to, the bases of the legs; metapleura very often entirely dark, but usually with considerable yellow pile; sides of the median segment and metanotum usually entirely dark, but sometimes with some yellow pile.

Abdomen.—Tergum: segment one usually entirely dark, but occasionally with a touch of yellow on its anterior corners, or even on its middle portion; segment two usually entirely dark, but often with more or less yellow pile on the sides of its hind border; segment three black in the middle, the sides being entirely covered with yellow pile, or at least with yellow on their hind portions; segments four and five usually dark in the middle and with yellow pile on the sides, the latter, however, sometimes entirely or almost entirely dark. Segment six dark, but usually with ferruginous pubescence running back from the apex considerably on each side. Venter dark, but with considerable brownish-ferruginous pubescence on the apical portion of the apical segment. Lateral carinæ of hypopygium much less elevated, and with their front portions more rounded, than those of *latitarsus*, their hind portions distinctly and somewhat suddenly lower than their front portions.

Wings.—Moderately stained with brown; the fore pair usually darkest in the region beyond the veins.

Legs.—Dark. Sarothri about three times as long as their greatest breadth, their posterior margins nearly straight.

Dimensions.—Female: length, 13½ mm. to 18 mm.; spread of wings, 32 mm. to 38 mm.; width of abdomen at second segment, 7 mm. to 9 mm.

Redescribed from many specimens.

Habitat.—I have records of this species as follows: New Mexico (Beulah and Cloudcroft), Utah, Colorado, Oregon, Montana (Missoula, Gallatin County, Ravalli County, Big Fork, Bozeman, Bridger Cañon, Sedan), Washington (Pullman), New York (Ithaca, two specimens), New Hampshire (one specimen), British Columbia (Vancouver, Glacier and Kaslo), Alberta (Mt. Edith) and Quebec (Saguenay River, three specimens). I also have a somewhat uncertain record

of a specimen from Berg Bay, Alaska (a specimen obtained by the Harriman Alaskan Expedition, in the collection of the American Entomological Socity). Mr. Swenk (Ent. News, July, 1907, p. 297) reports the species from Sioux County, Nebraska. It is evidently a Boreal and Transition species and is extremely rare in the East, but rather common in the West. More extensive collecting will certainly greatly increase our knowledge of the habitat of this species. It is pretty certainly present in parts, at least, of Wyoming and Idaho and in North Dakota, Minnesota, Wisconsin and Michigan, and in the Canadian provinces to the north of these latter states.

This species has its closest ally in *bicolor*, *laboriosus* and *variabilis* being, in order, the next nearest related forms. It may be separated from *bicolor* and *variabilis* by the difference in the coloration of its metapleura and from *laboriosus* by means of the differences in coloration of the dorsum of the thorax and abdomen.

I believe this species is the female of *consultus*. While I have seen no specimens of *consultus* from the East, it must be remembered that *insularis* is very rare here. I believe that *consultus* will yet be found to be present in the East, extreme rarity accounting for its absence from the collections which I have examined. It is just possible, also, that the very few specimens of *insularis* which I have seen, supposed to have been collected in the East, have by some mistake been given incorrect locality labels.

This species closely resembles the female of *campestris*, as Cresson and Handlirsch have stated, but the hind metatarsi of *campestris* are noticeably shorter for their width than are those of this species, and the lateral carinæ of the hypopygium of *campestris* are much more strongly elevated and evenly rounded from front to rear. I have carefully compared specimens of *campestris*, labelled by Schmiedeknecht, with specimens of both *insularis* and *latitarsus*.

The name *interruptus*, given by Greene, cannot properly be used for this species, as Cresson has shown, because the same name was used by Lepeletier for another species of

this genus years before Greene's description appeared. Furthermore, the year before Greene used this name with the genus name *Bombus*, Kirchner described another species, giving it the name *Bombus interruptus*, and that would necessitate the rejection, as a homonym, of the name *interruptus* for this species.

Psithyrus consultus new name.

Apathus insularis Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 113, ♂, var. b. (possibly a misidentification).

Psithyrus suckleyi Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111 (nom. nud.).

Types.—Described from thirty-three cotypes, which are deposited in various collections as follows: United States National Museum, Museum of Brooklyn Institute, Massachusetts Agricultural College, Montana Agricultural College, American Entomological Society, Entomological Society of Ontario, Cornell University, and the private collections of Mr. J. C. Crawford and Mr. H. L. Viereck.

Much resembles the male of laboriosus, but with some of the dorsal abdominal segments beyond the third bearing more or less yellow pile.

Female.—I believe this species to be the male of *P. insularis*. See the discussion following the description of *insularis*.

Male. Head.—Face usually with a distinct, though sometimes faint, tuft of yellow above the bases of the antennæ, and also sometimes with a few yellow hairs between the bases of the antennæ, otherwise entirely dark; occiput with a large triangular patch of yellow pile; cheeks dark. Malar space shorter than its width at the apex, about one-sixth as long as the eye. Clypeus clothed with black pile. Flagellum of antenna about three and one-third times as long as the scape; the fifth antennal segment much longer than the third, the third somewhat longer than the fourth.

Thorax.—Dorsum yellow, with (rarely without) a black band between the bases of the wings, this band being rather poorly defined, and very often extending back, in the middle, onto the middle of the scutellum; mesopleura mostly covered with yellow pile to the bases of the legs; metapleura variable, sometimes with mostly dark and sometimes with mostly yellow pile; sides of the median segment mostly dark.

Abdomen.—Dorsum: segment one yellow; segment two yellow, but often with more or less black pile on each anterior corner; segment three yellow; segment four sometimes mostly covered with yel-

ow pile, but usually more or less black in the middle and sometimes with yellow only on the extreme sides; segment five sometimes mostly black, but usually black in the middle with yellow pile on the extreme sides; segment six usually entirely or almost entirely black, but often with a little yellow pile on the extreme sides; segment seven dark. Venter dark in the middle, but usually with considerable yellow hair on the sides.

Genitalia.—Outer and inner spathæ much like those of *laboriosus*. Claspers much like those of *laboriosus* (fig. 94). Sagittæ like those of *variabilis* (fig. 97) and *laboriosus*.

Wings.—Somewhat stained with brown; the fore pair generally darkest in the region beyond the veins.

Legs.—Mostly black; the tarsi with more or less ferruginous hair.

Dimensions.—Length, 10 mm. to 14 mm. Spread of wings, 23 mm. to 30 mm. Width of abdomen at second segment, 4½ mm. to 6 mm.

Habitat.—I have records of this species as follows: British Columbia (Mt. Arrowsmith, Kelowna and Fort Macleod), Alberta (Banff), Saskatchewan (Regina), Washington (Pullman, Blue Mountains and Ellenburg), Montana (Missoula and Gallatin County), Utah (Logan), Colorado (Pagosa Peak, Ward and Manitou Park) and New Mexico (Magdalena Mountains). It is probably also present in Oregon, Idaho, Wyoming and northern California. It is mainly a Boreal and Transition species.

The fact that *consultus* and male *laboriosus* are closely related, as shown by their structure, while *insularis* and female *laboriosus* are also closely allied, as also shown by structure, is further strong evidence that *consultus* is the male of *insularis*.

Psithyrus bicolor new species.

Type.—Described from a single female deposited in Prof. T. D. A. Cockerell's private collection. Prof. Cockerell collected this specimen at Rociada, New Mexico.

Much like the female of P. insularis Smith, but with the lower halves of the pleura dark.

Female. Head.—Face with a strong touch of yellow pile above the bases of the antennæ. Occiput with a large triangular patch of yellow pile. Otherwise mostly dark. Malar space distinctly shorter than its width at the apex, about one-fourth as long as the eye. Clypeus coarsely punctate.

Thorax.—Dorsum mostly covered with yellow pile, but with the disc

strongly darkened and thinly clothed with hair. Mesopleura with yellow pile extending half way from the bases of the wings to the bases of the legs, their lower portions being entirely dark. Metapleura and the sides of the median segment black.

Abdomen.—Dorsum: segment one dark; segment two dark, with slight touches of yellow on the extreme posterior corners; segment three mostly dark, but with yellow pile on the hind corners and extending from them slightly toward the middle line along the hind margin; segment four mostly dark, but with the posterior two-thirds of the sides bearing yellow pile, this pile reaching out somewhat towards the middle line along the hind margin, also the very middle of the segment with a very small scattering tuft of yellow hairs; segment five yellow on the extreme sides, but dark in the middle; segment six dark, with brownish-ferruginous pubescence at the tip. Venter dark, with brownish-ferruginous pubescence around the apex of the hypopygium.

Wings.—Somewhat stained with brown, but not very dark.

Legs.—Dark. Hind metatarsi much as in *variabilis*.

Dimensions.—Length, 16½ mm. Spread of wings, 37 mm. Width of abdomen at second segment, 7½ mm.

This specimen resembles the females of *P. variabilis* quite strongly, except for the yellow pile on the dorsum of the abdomen, and it may possibly be only a variety of that species.

Psithyrus variabilis (Cress.) D. T.

Apathus variabilis Cresson, Trans. Amer. Ent. Soc., IV, 1872, p. 284, ♀ ♂.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
Psithyrus " Dalla Torre, Cat. Hym., X, 1896, p. 573.
" " Robertson, Trans. Amer. Ent. Soc., XXIX, 1903, p. 178, ♀ ♂.
" " Swenk, Ent. News, XVIII, July, 1907, p. 297, n. 1.
" " Cockerell, Trans. Amer. Ent. Soc., XXXII, 1906, p. 312.

Types.—Originally described from three females and two males, all from Bosque County, Texas, and in the collection of the American Entomological Society.

Occiput with a large triangular patch of yellow pile. Dorsum of thorax bearing rather dull yellow pile before and behind, with a black interalar band or with only the disc dark. Pleura dark. Abdomen of

female entirely dark; that of the male quite variable. Wings rather dark brown. Malar space of female distinctly shorter than its width at apex.

Female. Head.—Face often with a sprinkling of yellow hairs above the bases of the antennæ; otherwise dark, except for a large triangular patch of yellow pile on the occiput and even this yellow patch usually with at least a slight admixture of dark hairs. Malar space somewhat shorter than its width at the apex, about one-fourth as long as the eye. Clypeus coarsely punctate. Flagellum of antenna about one and four-fifths times as long as the scape; third and fifth antennal segments subequal in length, the fourth distinctly shorter than either.

Thorax.—Dorsum mostly covered with yellow pile. The disc, between the bases of the wings, always dark and thinly clothed, this dark and thinly clothed area extending back onto the scutellum in the middle. The dark color of the hair on the disc often extending to the base of the wing on each side so as to form a poorly defined dark interalar band. Mesopleura entirely covered with dark pile from slightly below the level of the bases of the wings. Metapleura and sides of the median segment dark.

Abdomen.—Dorsum and venter both dark, except for brownish-ferruginous pubescence on the apex of the last segment.

Wings.—Rather dark brown; the fore pair usually lightest across their middle portions.

Legs.—Dark. Hind metatarsi much as in *laboriosus* and *insularis*.

Male. Head.—Dark, except for a triangular patch of yellow pile on the occiput, this patch with at most only a slight admixture of dark hairs. Malar space shorter than its width at the apex, about one-fifth as long as the eye. Clypeus covered with black pile. Flagellum of antenna about three and one-fourth times as long as the scape; fifth antennal segment much longer than the third, the third longer than the fourth.

Thorax.—Dorsum with pile colored much like that of queen, but usually with a distinct black band between the bases of the wings. Mesopleura usually about like those of the queen, but with the yellow pile sometimes running down for some distance below the bases of the wings. Pile of metapleura and sides of the median segment dark.

Abdomen.—Dorsum: segment one usually entirely dark, but often with a more or less strong admixture of yellow hairs especially toward the sides; segment two usually entirely dark, but occasionally with a touch of yellow pile near the hind margin on the sides (one specimen before me has this segment very largely clothed with yellow pile, only its anterior corners and its anterior margin in the middle being dark); segment three mostly dark, but with considerable yellow pile on the

sides, especially on the posterior corners, with a strong tendency to reach out from these corners along the hind margin toward the middle line of the segment and occasionally bordering this margin all the way across (one specimen has this segment entirely clothed with yellow pile); segment four usually mostly dark with yellow pile on the extreme sides, but sometimes with the yellow pile also extending in toward the middle of the segment on each side, especially along the hind border (one specimen has this segment entirely yellow); segment five mostly dark, usually with more of less yellow pile on the extreme sides; segment six dark, sometimes with a touch of yellow on the extreme sides; segment seven dark. Venter mostly dark.

Genitalia.—Outer spatha (fig. 112) with its anterior lateral projections very long and narrow, its anterior margin being deeply and evenly incurved; side margins broadly and gradually outcurved; hind margin usually somewhat irregularly, but not very strongly, trilobate; hind portion of the ventral surface bearing long branched hairs, especially toward the sides and toward the hind margin; a small fenestra usually present, placed on the middle line, some little distance back from the anterior margin. Inner spatha (fig. 59) with its anterior margin projecting forward strongly in the middle, the projection being heavily chitinized; the side margins very abruptly bent inward in front, their posterior portions nearly straight and approaching each other very gradually toward the broadly rounded tip; apical portion of the ventral surface thickly covered with branching hairs; a large oval fenestra present in the middle, and usually a small one on each side, placed well out in the lateral projection. Clasper with branch of good width, its apex being broadly rounded; squama very strongly bilobed, the inner lobe comparatively large and prominent and bearing a very heavy brush of branching hairs, and the outer lobe often pointed and slightly hooked at the tip; volsella pointed, with the posterior half of its inner margin broadly, though not very deeply, incurved. Sagitta with a rather long narrow shaft and foliaceous recurved head.

Wings.—Somewhat stained with brown; somewhat lighter than those of the female.

Legs.—Dark; the tarsi more or less ferruginous.

Dimensions.—Length: female, 16 mm. to 18 mm.; male, 13 mm. to 17 mm. Spread of wings: female, 38 mm. to 41 mm.; male, 35 mm. to 38 mm. Width of abdomen at second segment: female, $7\frac{1}{2}$ mm. to 9 mm.; male, $5\frac{1}{2}$ mm. to 7 mm.

Redescribed from five females and twelve males.

Habitat.—I have seen specimens of this species from Texas (Dallas, Bosque County, Cotulla, Austin, Trinity, Victoria, Goldthwait), Kansas (Baldwin, several specimens) and Ala-

bama (a single male). Robertson has reported it from Illinois, Swenk from Nebraska (Lincoln, Ashland, Seward and West Point) and Cockerell from New Mexico (Tuerto Mountains—8200 feet altitude).

This species seems to have its closest allies in *P. insularis* Cresson and *P. consultus*, though *P. laboriosus* appears to be about as closely related.

Psithyrus crawfordi new species.

Types.—Described from one female and one male, the former from Placer County, California, and the latter from Oregon, both deposited in the collection of the United States National Museum.

Both sexes with a tuft of yellow pile above the bases of the antennæ and with a triangular patch of pile of the same color on the occiput; thorax with the dorsum yellow in front, but otherwise mostly dark; abdomen with yellow pile on the sides of a portion of the apical half of the dorsum, otherwise dark.

Female. Head.—Face with a conspicuous yellow tuft above the bases of the antennæ and with a few yellow hairs mixed with the black in the middle just below them. Occiput with a large triangular patch of pure yellow pile. Otherwise mostly dark. Malar space distinctly shorter than its width at the apex, about one-fourth as long as the eye. Third and fifth antennal segments subequal in length, the fourth distinctly shorter than either.

Thorax.—Dorsum with its anterior portion covered with yellow pile back to the bases of the wings, the remainder being black. The disc only thinly clothed. Mesopleura with their anterior portions bearing yellow pile for some distance below the bases of the fore wings, but their hind and lower portions dark. Metapleura and sides of the median segment dark.

Abdomen.—Dorsum: segments one and two black; segment three dark, with yellow pile on the posterior corners; segment four dark in the middle, with yellow pile on the sides and extending well toward the middle line of the body along the hind margin; segment five dark, with yellow pile on each side; segment six dark, with brownish-ferruginous pubescence about the apex. Venter dark, the apical portion of the hypopygium bearing considerable brownish-ferruginous pubescence; the ridge-like posterior portions of the lateral elevations of the hypopygium much more prominent than those of the other species of this group, more nearly equalling the rounded anterior portions in height and being, in fact, but little lower than those portions.

Wings.—Only moderately stained with brown, the fore pair being slightly the darkest in the region beyond the veins.

Legs.—Dark. The hind metatarsi as already described for the group, their posterior distal terminal projections exceptionally long and acute.

Male. Head.—Face with a strong touch of brownish-yellow hairs both between and above the bases of the antennæ; occiput with a triangular patch of yellow pile; otherwise dark. Malar space between one-fourth and one-fifth as long as the eye. Clypeus covered with black pile. Fifth antennal segment distinctly longer than the third; the third longer than the fourth.

Thorax.—Anterior part of the dorsum covered with yellow pile back to the tegulæ; the remainder of the dorsum dark except for a rather faint sprinkling of yellow hairs on the sides of the scutellum. Each mesopleuron with a strong sprinkling of yellow pile on its front half reaching well down toward the bases of the legs, the remaining portion being dark. Metapleura and median segment dark.

Abdomen.—Dorsum: segments one and two dark; segment three mostly dark, but with yellow pile on its posterior corners and also a little of the same color on its hind margin; segment four mostly yellow, but with a strong admixture of black hairs on the very middle; segment five mostly dark, but with yellow pile on the extreme sides; segments six and seven dark. Venter dark.

Wings.—Of about the same shade as those of the female.

Legs.—All dark, except the tarsi.

Dimensions.—Length: female, 15 mm.; male, 15 mm. Spread of wings: female, 29 mm.; male, 28 mm.

It is quite possibe that these two specimens, coming from such widely separated localities, do not belong to the same species, but they are so much alike in general appearance that it is my belief that they belong together, and I have thought it better, under the circumstances, to describe them as female and male of the same species than to describe them as two separate new species.

THE ASHTONI GROUP.

Characters of the Group.

Female.—Occiput with at most only a sprinkling of yellow hairs. Malar space medium. Hind metatarsi very broad, about two and one-half times as long as their greatest width. Lateral elevations of hypopygium very prominent.

Male.—Flagellum of antenna about three times as long as the scape; the third and fifth antennal segments subequal in length. Clasper of genitalia (figs. 91, 92, 96, 99) with

squama at most not very strongly bilobed, the inner lobe being pointed and the outer one very broadly rounded. Sagitta of characteristic form, with head and shaft rather strongly demarcated from each other by the incurving or notching of the outer margin at the base of the former; shaft without a very prominent tooth-like projection on its ventral side.

Psithyrus ashtoni (Cress.) D. T.

Apathus ashtoni Cresson, Proc. Ent. Soc. Phila., III, 1864, p. 42, n. 7, ♀.
" " Packard, Proc. Essex Inst., IV, 1864, p. 118, ♀; T. 3, F. 1.
" " Packard, Amer. Natural., II, 1868, p. 203, T. 5, F. 1.
" " Packard, Our Common Insects, T. 1, F. 1.
" " Cresson, Trans. Amer. Ent. Soc., VII, 1879, p. 230 (Catal.).
" " Bowles, Ann. Rep't Ent. Soc. Ont., 1880, p. 33.
" " Provancher, Natural. Canad., XIII, 1882, p. 268, n. 2, ♀.
" " Provancher, Faun. Ent. Can. Hym., 1883, p. 736, n. 2, ♀.
" " Cresson, Syn. Hym. No. Amer., 1887, p. 307 (Catal.).
" " Packard, Guide to Study of Insects, p. 131, T. 3, F. 1, ♀.
" " Provancher, Addit. Faun. Can. Hym., 1888, p. 342, ♀.

Psithyrus ashtoni Dalla Torre, Cat. Hym., X, 1896, p. 565 (Catal.).
? *Bombus ashtoni* Harvey and Knight, Psyche, VIII, 1897, p. 79.
Psithyrus variabilis Howard, Insect Book, 1904, Plate II, fig. 35.
" *ashtoni* Lovell, Ent. News, XVIII, May, 1907, p. 199.
? " *latitarsus* Titus, Biol. Surv. Mich., Ecology of Isle Royale, Lake Superior, 1908, p. 317.
" *consultus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111 (pars).

Types.—The females described by Cresson are in the collection of the American Entomological Society. The males, on which Lovell based his short description of that sex, are probably in his private collection.

Female.—Head mostly or entirely dark; dorsum of thorax yellow in front, sometimes yellow and sometimes dark behind; upper parts of the pleura yellow, but their lower portions dark; dorsum of abdomen with the fourth segment and the hind corners of the third clothed with yellow

pile and usually with considerable yellow on the sides of the fifth, the remainder being dark. Venter and legs dark.

Male.—Face dark; occiput with more or less yellow pile; dorsum of thorax entirely yellow, or with an indefinite black interalar band, or with the whole hind portion with mostly dark pile; the upper parts of the pleura yellow, the lower parts being either dark or yellow; dorsum of abdomen colored much like that of the female, but with the first segment and the extreme sides of the sixth usually bearing yellow pile.

Female. Head.—Face entirely dark; occiput usually entirely dark, but sometimes with a slight sprinkling of yellow hairs; cheeks dark. Malar space shorter than its width at the apex, about one-fifth as long as the eye. Clypeus, for the most part, densely and rather coarsely punctate. Flagellum of antenna about one and four-fifths times as long as the scape; third antennal segment somewhat longer than the fifth, the fifth longer than the fourth.

Thorax.—Dorsum sometimes entirely yellow, often yellow with only a dark spot on the center of the disc, but often with the scutellum and the region between the bases of the wings more or less dark, and sometimes entirely so; the very center of the disc naked; mesopleura with their upper halves mostly or entirely yellow and their lower halves dark; metapleura and sides of the median segment mostly or entirely dark, the former often with a little yellow pile.

Abdomen.—Dorsum: segments one and two dark; segment three dark, but with yellow pile on its hind corners; segment four yellow; segment five black in the middle and with more or less yellow pile on the sides; segment six black, usually with brownish-ferruginous pubescence running forward from the apex in a broad line on each side. Venter mostly dark, with some yellow hairs on the sides of the middle portion. Hypopygium with considerable brownish-ferruginous pubescence on its apical portion; the lateral elevations high and gradually rounded over from front to rear.

Wings.—Somewhat stained with brown; the fore pair usually darkest in the region beyond the veins.

Legs.—Black; the hind metatarsi with their posterior margins strongly arcuated.

Male. Head.—Face entirely black; occiput always with a sprinkling of yellow hairs, and occasionally with a distinct triangular patch of pure yellow pile; cheeks black. Malar space shorter than its width at the apex, about one-fifth as long as the eye. Clypeus mostly covered with black pile. Flagellum of antenna about three times as long as the scape; third and fifth antennal segments subequal in length, the fourth distinctly shorter than either.

Thorax.—Coloration in general much like that of the thorax of the female and showing the same variations, but the scutellum more often entirely yellow, it sometimes being yellow with the region between

the bases of the wings at the same time more or less dark, thus forming an indefinite interalar band; the mesopleura often yellow to the bases of the legs.

Abdomen.—Dorsum: segment one occasionally entirely dark and often with yellow only on the sides, but usually covered with yellow pile; segment two dark; segment three dark, with yellow pile on the hind corners; segment four yellow; segments five and six black in the middle and yellow on the sides; segment seven black. Venter sometimes almost entirely dark, but usually with considerable yellow hair, at least on the sides of the middle portion.

Genitalia.—Outer spatha (fig. 60) long for its width; its anterior margin broadly but deeply incurved, its side margins nearly straight and converging posteriorly and its hind margin arcuate; each anterior lateral projection with a small pointed projection on its outer side near the end; ventral surface with a scattering tuft of very long hairs on each side of the middle. Inner spatha long for its width (fig. 141), its front margin projecting forward strongly and heavily chitinized in the middle; its side margins sharply incurved in front and outcurved behind; its hind margin curved forward somewhat in the middle, so as to make the apex feebly bilobate; the apical portion of the ventral surface, except along the middle line, rather densely clothed with long, branched hairs. Claspers (figs. 92 and 99) with branches slender and rounded at the apex as seen from dorsal side; each squama with its margin outcurved on its outer side and at its apex, but somewhat incurved on the inner side of its apical portion so as to form a broadly rounded outer lobe with a pointed inner projection; each volsella more or less pointed at its apex, its outer margin out-curved and its inner margin usually somewhat out-curved behind the middle, but strongly incurved in front. Sagittæ much like those of *suckleyi* and *variabilis*, but characterized by a very sharp indentation, in the outer side of each, between the head and the shaft.

Wings.—Usually somewhat lighter than those of the female; subhyaline.

Legs.—Mostly dark.

Dimensions.—Length: female, 13 mm. to 18 mm., male, 11 mm. to 16½ mm. Spread of wings: female, 30 mm. to 39 mm.; male, 28 mm. to 35 mm. Width of abdomen at second segment: female, 7 mm. to 10 mm.; male, 6 mm. to 7½ mm.

Redescribed from several females and many males.

Habitat.—I have records of this species as follows: Canada (Ontario; Meach Lake, Montreal and Maisonneuve in Quebec; Hampton on Prince Edward Island; a small male from Regina, Province of Saskatchewan), Maine (Waldoboro and Brunswick), New Hampshire (Conway, Durham

and Twin Mountain), Vermont, New York (Ithaca), Massachusetts, Connecticut, Pennsylvania, Virginia and Minnesota. It is mainly a Transition species. Further collecting will probably extend its recorded habitat. It is probably present in most of the Transition Zone territory between the province of Saskatchewan and New York.

The female of this species is most closely related to *latitarsus* Morrill, but the lateral carinæ of the hypopygium are less elevated than are those of that species. The male has its closest ally in *suckleyi*, as is shown both by its coloration and by its every structure (including the genitalia), but it may be conveniently separated from that species by means of the different coloration of its second dorsal abdominal segment.

Psithyrus latitarsus Morrill.

Psithyrus latitarsus Morrill, Can. Ent., XXXV, 1903, p. 224 (with figures showing distinguishing structures).
" " Swenk, Ent. News, XVIII, July, 1907, p. 297.

Types.—Type from Bozeman, Montana, deposited in collection of Massachusetts Agricultural College; cotypes at Massachusetts Agricultural College, "U. S. Nat. Museum and Montana Agricultural College."

Head mostly black. Dorsum of thorax yellow, but usually with a distinct black band between the bases of the wings; pleura yellow to the bases of the legs. Dorsum of abdomen with segment one usually having a slight touch of yellow on its anterior corners, but often entirely dark; segment two dark; segment three dark, but usually with yellow pile on its posterior corners; segment four dark in the middle and yellow on the sides; segment five dark, but usually yellow on the extreme sides; segment six, venter and legs dark. Malar space medium. Hind metatarsi broad. Lateral elevations of hypopygium very prominent.

Female. Head.—Often entirely dark; the occiput usually with a faint sprinkling of yellow hairs. Mandibles (fig. 49) usually with their biting margin slightly notched in the middle. Malar space shorter than its width at the apex, about one-fifth as long as the eye. Clypeus, for the most part, densely and coarsely punctate. Flagellum of antenna about one and three-fourths times as long as the scape; the third antennal segment longer than the fifth, the fifth longer than the fourth.

Thorax.—Dorsum yellow, usually with a distinct, but rather poorly defined, black band between the bases of the wings, this band occa-

sionally partly or entirely obliterated on the sides, leaving only a black spot on the disc. The center of the disc bare. Mesopleura covered with yellow pile to, or very nearly to, the bases of the legs; metapleura with considerable yellow pile; sides of the median segment mostly dark.

Abdomen.—Dorsum: segment one dark, but usually with a slight touch of yellow on its anterior corners; segment two dark; segment three dark, but usually with a strong touch of yellow pile on its hind corners; segment four dark on the middle (at least on the basal middle) and with yellow pile on the sides; segment five mostly dark, but with yellow pile on the extreme sides; segment six dark, but each side with a broad and somewhat indefinite, but distinctive, line of brownish pubescence. Venter dark, the apical portion of the apical segment with considerable brownish pubescence. Each side of the hypopygium with a very strongly elevated and angular process or carina, visible even from the dorsal side, the two carinæ converging posteriorly, becoming less pronounced and disappearing near the tip of the segment.

Wings.—Somewhat stained with brown, but not strongly so.

Legs.—Entirely dark. Length of hind metatarsus about two and one-half times its greatest width, its posterior edge strongly arcuated.

Dimensions.—Length, 15 mm. to 19 mm. Spread of wings, 35 mm. to 42 mm. Width of abdomen at second segment, 8½ mm. to 9½ mm.

Redescribed from nineteen females, one of them being the type and six being cotypes.

Habitat.—I have records of this species as follows: Montana (Bozeman, Gallatin County, Big Fork), British Columbia (Vancouver and Kaslo), Washington (Blue Mountains). There is a specimen before me bearing the locality label "Ithaca, New York," but I consider this record very questionable. This is apparently a pretty strictly Boreal form.

P. ashtoni is by far the closest ally of this species, as is shown by its structure. The two species may be readily separated by the differences in coloration of the pleura and of the fourth dorsal abdominal segment. I cannot agree with Mr. Swenk in considering *laboriosus* more closely related to *latitarsus* than is *insularis.*

P. insularis, which resembles this species considerably in coloration, can be separated from it, as Dr. Morrill made clear, by its longer malar space, its more narrow hind metatarsi, and the less prominent lateral elevations on its hypopygium. This species can also be separated readily from *campestris*, as Dr. Morrill has shown.

The black hair on certain portions of this insect, especially on the abdomen, is tipped slightly with brownish.

I think that this species is the female of *suckleyi*.

Psithyrus suckleyi (Greene).

Bombus suckleyi Greene, Ann. Lyc. Nat. Hist. New York, VII, 1860, p. 169, n. 1, ♂.

Apathus insularis Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 113, ♂, var. a. (Probably a misidentification.)

Psithyrus interruptus Dalla Torre, Cat. Hym., X, 1896, p. 569 (pars.).

" *consultus* Fletcher and Gibson, Can. Ent. Rec. (Ann. Rep't Ent. Soc. Ont.), 1908, p. 111 (pars).

Type.—From Puget Sound. Probably lost.

Face dark; occiput with considerable yellow pile; cheeks dark; dorsum of thorax yellow, with a narrow black interalar band; pleura yellow; dorsum of abdomen with first segment yellow, second segment dark on the sides and usually along the apical margin, but yellow in the middle, at least on the basal portion, third segment sometimes entirely yellow, except for dark pile on the anterior corners, and sometimes dark in the middle and along the front margin also, fourth segment mostly yellow, fifth and sixth segments dark in the middle and yellow on the sides, seventh segment dark; venter dark in the middle, with considerable yellow hair on the sides; legs mostly dark.

Female.—I believe that *latitarsus* is the female of this species, but have been unable to definitely prove that such is the case, though I have evidences as follows: (1.) The known habitats of *latitarsus* and *suckleyi* are nearly the same. (2.) The male of *ashtoni* is evidently the closest relative of *suckleyi*, as shown both by structure and by coloration, and the female *ashtoni* is structurally most like *latitarsus*.

Male. *Head*.—Face black, often with an admixture of yellow hairs above the bases of the antennæ; occiput with a triangular patch of yellow pile, often with dark hairs admixed; cheeks dark. Malar space shorter than its width at the apex, hardly one-fifth as long as the eye. Clypeus clothed with black pile. Flagellum of antenna nearly three times as long as the scape; third and fifth antennal segments subequal in length, the fourth distinctly shorter than either.

Thorax.—Dorsum yellow, with a narrow and rather poorly defined black band between the bases of the wings; mesopleura mostly covered with yellow pile to the bases of the legs; metapleura with considerable yellow pile; sides of the median segment mostly dark, but often with considerable light hair admixed.

Abdomen.—Dorsum: segment one yellow; segment two yellow in the middle and dark on the sides, often dark also along the apical border; segment three usually with mostly yellow pile, but usually

with a strong admixture of dark hairs, especially in the middle, and with a black touch on each anterior corner; segment four mostly yellow; segment five more or less black in the middle, with yellow pile on the sides; segment six black in the middle and yellow on the extreme sides; segment seven black. Venter usually with a large amount of yellow pile, especially on the sides; the apex of the last segment bearing ferruginous pubescence.

Genitalia.—Outer and inner spathæ much like those of *ashtoni* (figs. 60 and 141). Claspers (figs. 91 and 96) much like those of *ashtoni*, but with the margin on the inner side of the apex of each squama less strongly incurved than in that species; sagitta much like that of *ashtoni*, but not with so sharp an indentation on its outer side between the head and the shaft (it does usually, however, have a sharper indentation than that shown in fig. 96).

Wings.—Somewhat stained with brown, almost subhyaline.

Legs.—Mostly dark; the tarsi often with considerable, and the tibiæ sometimes with more or less, ferruginous hair.

Dimensions.—Length, 13 mm. to 14 mm. Spread of wings, about 32 mm. Width of abdomen at second segment, about 6½ mm.

Redescribed from thirteen specimens.

Habitat.—I have records of this species as follows: British Columbia (Kaslo, Duncans, Nelson and Mt. Cheam), Alberta (St. Albert—one male), Montana (Missoula and Gallatin County), Idaho (Moscow and Beaver Cañon), Utah (Beaver Range Mountains—8,000 to 10,000 feet altitude) and California (Santa Clara County). It is probably also present in Washington, Oregon and Wyoming and possibly in Colorado. It seems to be mainly a Boreal species.

This species can, as a rule, be readily separated from the male of *ashtoni* by means of the yellow pile on the middle of its second dorsal abdominal segment. It does not vary very much, as does the *ashtoni* male, in the coloration of its pleura and scutellum.

This species does not seem to agree very well with Greene's original description of *suckleyi*, but it does agree with Cresson's description of what was apparently Greene's type specimen, and, on the basis of Cresson's remarks in regard to the matter (Proc. Ent. Soc. Phila., II, 1863, pp. 113 and 114) I adopt the name *suckleyi* for this species.

THE FERNALDÆ GROUP.

Characters of the Group.

Female.—Malar space rather long; apex of abdomen unusually strongly recurved, the apical segment very pointed at apex, and the very tip of the hypopygium usually extending distinctly beyond the apex of the last dorsal abdominal segment; hind metatarsi fully three times as long as their greatest width.

Male.—Flagellum of antenna nearly three times as long as the scape; the third and fifth antennal segments subequal in length. Branches of claspers (figs. 95 and 98) rather strongly pointed at tip as seen from dorsal side; squamæ strongly bilobed, the inner lobe being the larger and triangular in form and the outer one being elongate and rounded at the tip; volsellæ very slender and of about even width beyond the tips of the squamæ, each having a prominent rounded lobe on its inner side just about opposite the inner lobe of the squama, this lobe and the tip of the volsella being bushy with numerous hairs. Shaft of sagitta with a prominent tooth-like projection on its ventral side beyond the middle. Apex of abdomen with considerable ferruginous pile above. Hairs fringing the hind tibiæ and the hind margin of the posterior metatarsi very long, longer than in either the *Ashtoni* or the *Laboriosus* group.

Psithyrus fernaldæ Franklin.

Psithyrus insularis Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 130 (pars).

" " Ashmead, Hym. of Alaska, 1904, p. 136 (pars).

" *fernaldæ* Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 164, ♀.

Types.—Described from seventeen females, of which five are deposited in the collection of the Massachusetts Agricultural Colege, four in the collection of New Hampshire College and the remainder (8) in the collection of the United States National Museum.

Face dark; occiput with yellow pile; dorsum of thorax entirely covered with yellow, or with a dark spot on the disc, or with a distinct dark

interalar band; pleura yellow to, or nearly to, the bases of the legs, or with their entire lower half dark; dorsum of abdomen usually with yellow on the sides of the first segment and on the sides of the apical margin of the third, but sometimes entirely dark except for the yellow on the fourth segment and the light ferruginous pubescence on the apical portion of the apical one.

Female. Head.—Face sometimes with a slight yellow touch above the bases of the antennæ, but usually entirely dark; occiput with a large triangular patch of yellow pile; cheeks dark. Malar space nearly as long as its width at the apex, about one-fourth as long as the eye. Clypeus with its front part, especially in the middle, somewhat sparsely punctate, its base and sides being more or less densely punctate. Flagellum of antenna nearly twice as long as the scape; the third antennal segment longer than the fifth and the fifth longer than the fourth.

Thorax.—Dorsum, except the small bare spot on the very center of the disc, sometimes clothed entirely with yellow pile, sometimes with a black spot on the disc and sometimes with a distinct, though poorly defined, black band between the bases of the wings; mesopleura usually covered with yellow pile to, or nearly to, the bases of the legs, but sometimes with their entire lower half dark; metapleura with considerable yellow pile or entirely dark; sides of the median segment dark, sometimes with a few light hairs admixed; extreme sides of the metanotum sometimes entirely dark, but generally with considerable yellow pile.

Abdomen.—Dorsum: segment one dark in the middle and usually with more or less yellow pile on the sides, but sometimes entirely dark; segment two dark; segment three dark, but usually with considerable yellow pile on the sides of its apical border; segment four, except some black pile on its very middle portion, covered with yellow pile; segment five dark, but often with considerable ferruginous hair on the sides; segment six strongly pointed at its apex and usually bearing light brownish-ferruginous pubescence over a considerable portion of its surface, this pubescence being very thick and matted about the very apex. Venter dark, sometimes with a few scattering yellowish or ferruginous hairs. Hypopygium very pointed at apex, its lateral carinæ rather strongly elevated and coming together posteriorly somewhat in front of the apex of the segment; the apical portion bearing a considerable amount of yellowish-ferruginous pubescence, and the very tip usually extending distinctly beyond the tip of the last dorsal segment.

Wings.—Considerably stained with brown, the fore pair usually darkest in the region beyond the veins.

Legs.—Mostly dark; the hind metatarsi fully three times as long as their greatest breadth, their hind margins slightly arcuate.

Dimensions.—Length, 12 mm. to 16 mm. Spread of wings, 29 mm. to 38 mm. Width of abdomen at second segment, $6\frac{1}{2}$ mm. to 9 mm.

Habitat.—I have records of this species as follows: Maine (Orono), Massachusetts (Amherst—a single ♀), New Hampshire (Webster, Durham, Crawfords, Mt. Washington and Conway), New York (Ithaca), Washington (Mt. Rainier), British Columbia (Kaslo and Metlakatla) and Alaska (Nushagak and Sitka). It belongs mainly to the Boreal region, but it runs over into the Transition Zone somewhat. Extensive collecting will probably extend the range of habitat given above considerably. In the West, it will probably be found to range south into Colorado and Northern California. In the East, it seems to be about as common as *ashtoni*. It is surely present in Vermont.

I am strongly of the opinion that *fernaldæ* is the female of *tricolor*. I have evidence to support this opinion as follows:

1. Both *fernaldæ* and *tricolor*, as shown by their structure, are without any very close allies in the New World, and they are the only species which appear to stand thus isolated.

2. They have about the same range of habitat, though *tricolor* has been taken in Colorado while *fernaldæ* has not.

3. The *fernaldæ* females alone ever have a touch of ferruginous pile on the sides of the fifth dorsal abdominal segment to correspond with the pile of the same color on the apex of the abdomen of the *tricolor* males.

4. The closest allies of *fernaldæ* known to me are the females of the European species, *P. quadricolor* and *P. globosus*, and the males of those same two species are the closest allies of *tricolor*, as shown by the descriptions, figures of genitalia, etc. of Schmiedeknecht (Apid. Europ., 1882, pp. 406 and 409 and Tab. 14, figs. 4, 5 and 6). There are specimens of both sexes of both *quadricolor* and *globosus*, labeled by Schmiedeknecht, in the collection of the Massachusetts Agricultural College and I have compared them carefully with specimens of *fernaldæ* and *tricolor*. I find, by this comparison, that both *quadricolor* and *globosus*, especially the former, are closely allied to both *fernaldæ* and *tricolor*. While I was unable to dissect any of these specimens of either *quadricolor* or *globosus*, on account of their value as authentic specimens, the genitalia of one of the *quadricolor* males were protruding from the end of the abdomen and I was thus enabled to compare even the genitalia of this species with those of *tricolor*. They are very similar, as Schmiedeknecht's figure shows. While *quadricolor* and *globosus* both differ noticeably, in some respects, in coloration from *fernaldæ* and *tricolor*, they all agree in a tendency to have some ferruginous pile on the apical portion of the abdomen.

I will here give the name *Psithyrus quadricolor* var. *confinis*, new name, to the variety of *Psithyrus quadricolor* which Schmiedeknecht (Apid. Europ., 1882–1884, p. 407) called *citrinus*, the name *citrinus* having been preoccupied by Smith's species (Catal. Hymen. Brit. Mus., II, 1854, p. 385, n. 7), which I have classed as the male of *laboriosus* (F.).

Psithyrus tricolor Franklin.

Apathus insularis Cresson, Proc. Ent. Soc. Phila., II, 1863, p. 113, ♂, var. c. (Probably misidentification.)
? *Psithyrus* " Ashmead, Proc. Wash. Acad. Sci., IV, 1902, p. 130 (pars).
? " " Ashmead, Hym. of Alaska, 1904, p. 136 (pars).
" *tricolor* Franklin, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 167, ♂.
Readily identified by its group characters.

Types.—Described from thirty cotypes, which are deposited in the following collections: United States National Museum, Massachusetts Agricultural College, Museum of Brooklyn Institute, New Hampshire College, Entomological Society of Ontario, Leland Stanford Jr. University, Colorado Agricultural College, American Entomological Society, and the private collections of Mr. J. C. Crawford, Prof. T. D. A. Cockerell, Mr. P. G. Bolster, Boston, Mass., and Mr. H. L. Viereck.

Female.—I believe that *fernaldæ* is the female of this species. See the discussion under *fernaldæ*.

Male. Head.—Face black, sometimes with a touch of yellow pile above the bases of the antennæ; occiput with a triangular patch of yellow pile; cheeks dark. Malar space nearly as long as its width at the apex, nearly one-fourth as long as the eye. Clypeus clothed with black pile.

Thorax.—Dorsum yellow, with a usually poorly defined black band between the bases of the wings, or at least with a large black spot on the disc (when a distinct band is present, it usually extends back, in the middle, onto the middle of the scutellum); mesopleura usually covered with yellow pile to the bases of the legs, but sometimes with their lower portions dark; metapleura sometimes dark and sometimes yellow, but usually with considerable yellow pile; sides of the median segment sometimes entirely dark, but usually with considerable light pile admixed.

Abdomen.—Dorsum: segment one entirely or mostly yellow; segment two sometimes entirely yellow, sometimes yellow in the middle with a black spot on each side, and sometimes entirely black; segment three entirely yellow, yellow on the sides and more or less black in the middle, or even nearly or entirely black; segment four yellow; segment five black, sometimes with a slight sprinkling of yellowish or ferruginous hairs; segment six often entirely clothed with ferruginous pile, but frequently with more or less black pile on the basal portion; segment seven with ferruginous or yellowish-ferruginous pile. Venter, at least on the sides, with considerable yellow pile.

Genitalia.—Outer spatha (fig. 54) with side and hind margins outcurved; the anterior margin deeply, broadly and evenly incurved; the ventral surface with a patch of scattering long hairs on each side of the middle. Inner spatha (fig. 146) with apical portion unusually narrow for its length; the margin rounded at the apex; ventral surface rather heavily clothed with moderately long and mostly branched hairs on the sides and apex of the apical portion; an oval fenestra usually present on each side of the middle line, about half-way from the front margin to the apex. Claspers and sagittæ as already described for the group.

Wings.—Somewhat stained with brown, often subhyaline; the fore pair usually darkest in the region beyond the veins.

Legs.—Mostly dark; the trochanters and femora often with considerable yellow pile; tibiæ and the very tips of the femora often with considerable ferruginous hair; the tarsi with more or less ferruginous hair.

Dimensions.—Length, 10½ mm. to 14 mm. Spread of wings, 25 mm. to 32 mm. Width of abdomen at second segment, 5½ mm. to 7 mm.

Habitat.—I have records of this species as follows: Alaska (Fort Wrangle, Juneau, Sitka and Fox Point), Alberta (Banff), British Columbia (Metlakatla), Washington (Olympic Mountains), Colorado (Ward and Pagosa Peak), New York (Brant Lake and Otto), Nova Scotia (Weymouth—P. G. Bolster collector) and New Hampshire (Durham, Webster and Mt. Washington). It is probably also present in the following states: Oregon, northern California, Idaho, Montana, Wyoming, Utah, North Dakota, Minnesota, Wisconsin, Michigan, Vermont, Maine and possibly parts of Massachusetts and Pennsylvania. It probably also ranges throughout a considerable portion of Canada, from the Atlantic to the Pacific Ocean. It is mainly a Boreal species, but it runs over into the Transition Zone somewhat.

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The names in italics are synonyms.

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Addenda and Corrigenda.

Page 179, line 22, for "conuection" *read* "connection."
" 184, line 24, for "on the" *read* "of."
" 185, line 10, for "with hair without" *read* "with hair on their outer sides."
" 186, line 26, for "*territris*" read "*terrestris*."
" 187, line 17, after "Sumatra" *insert* "and."
" 187, line 19, after "Corsica" *insert* "and."
" 187, line 30, after "*Psithyrus brasiliensis*" insert "(record doubtful)."
" 188, line 25, for "habitat" *read* "habitats."
" 188, line 27, for "habitat" *read* "habitats."
" 192, line 4 in "Species" column, for "ervidus" *read* "fervidus."
" 193, line 3 in "Species" column, for "mpatiens" *read* "impatiens."
" 196, line 45 in "Species" column, for "vollucelloides" *read* "volucelloides."
" 197, lines 7, 15 and 19 in "Species" column, for "vollucelloides" *read* "volucelloides."
" 198, line 15, for "*Bombus*" read "*Bombidæ*."
" 198, line 15, before "new" *insert* "valid."
" 198, last line, omit "and also in Greenland."
" 199, line 5, before "Upper" *insert* "Lower and."
" 199, line 29, for "are pretty certain indications" *read* "is a pretty certain indication."
" 200, line 31, for "and" *read* "or."
" 201, line 2, for "habitat" *read* "habitats."
" 203, line 3, after "clover" *insert* "seed."
" 203, line 8, for "of" *read* "to."
" 207, line 31, place a comma after "classified."
" 207, line 32, place a comma after "pile."
" 208, line 22, after "is," *insert* "proportionately."
" 208, line 37, after "eyes," *insert* ".)."
" 209, line 35, for "taxomomic" *read* "taxonomic."
" 211, line 26, after "usually," *insert* "long."
" 214, line 1, for "tubercule" *read* "tubercle."
" 215, line 4, for "beardered" *read* "bearded."
" 216, line 5, for "forms" *read* "form."
" 217, line 31, for "Agriculure" *read* "Agriculture."
" 218, line 12, after "mesothorax," *insert* "in front."
" 218, line 13, after "propodeum," *insert* "behind."
" 218, line 32, for "conneets" *read* "connects."

Page 219, line 10, after "having," *insert* "apparently."
" 220, line 5, for "nestigial neutral" *read* "vestigial ventral."
" 221, line 34, for "bulk-like" *read* "bulb-like."
" 223, line 30, for "apical portions of their outer surfaces" *read* "ventral surfaces of their apical portions."
" 224, line 37, for "has" *read* "as."
" 225, line 2, for "projection" *read* "projections."
" 225, line 33, for "overlays" *read* "overlies."
" 227, line 22, for "unclosed" *read* "open."
" 231, line 34, after "inner," *insert* "one."
" 232, line 4, place comma after "metatarsus."
" 232, line 31, for "abdominal segments" *read* "abdomen."
" 233, lines 33, 35 and 37, for "in" *read* "on."
" 234, lines 1 and 5, for "in" *read* "on."
" 238, line 3, for "numbers, but, while" *read* "numbers. While."
" 238, next to last line, omit semi-colon.
" 239, line 5, for "fed" *read* "feed."
" 241, line 25, after "squamæ," *insert* "the volsellæ bearing well developed apical projections."
" 242, line 30, place comma, instead of semi-colon, after first "pile."
" 244, line 18, for "front" *read* "vertex."
" 245, line 40, for "it" *read* "its."
" 245, line 45, for "front" *read* "vertex."
" 246, line 2, for "front" *read* "vertex."
" 247, lines 11 and 14, for "front" *read* "vertex."
" 247, line 14, omit "from."
" 247, line 41, place comma, instead of semi-colon, after "large."
" 247, lines 42 and 45, for "front" *read* "vertex."
" 248, lines 28 and 30, for "front" *read* "vertex."
" 248, line 42, for "terristris" *read* "terrestris"
" 250, line 5, place comma, instead of a semi-colon, after "marked."
" 252, line 19, omit "are."
" 252, line 20, for "bear" *read* "with."
" 244 to 255. In the tables, the meaning will be more clear if, for such expressions as "second abdominal segment covered above," substitutions be made reading like this, "second dorsal abdominal segment covered."
" 254, line 7, place comma, instead of semi-colon, after "large."
" 254, line 9, place comma, instead of semi-colon, after "small."
" 255, lines 2 and 5, for "the length of" *read* "as long as."
" 258, line 9, after "space," *insert* "nearly."
" 264, line 2, omit "fulvo-."
" 270, line 13, replace the semi-colon with a comma.
" 274, line 26, for "Lowell" *read* "Lovell."
" 276, line 1, for "lower" *read* "ventral."
" 276, lines 2 and 3, omit "and *occidentalis*."

Page 277, lines 32 and 33, omit "When viewed from in front," and begin sentence with "As."
" 278, lines 19 and 20, omit "the anterior border of yellow pile with a few black hairs intermixed."
" 278, line 22, after "notched," *insert* "with an inconspicuous indentation."
" 279, line 5, for "margins" *read* "margin."
" 279, line 15, for "middle; surface" *read* "middle, it's surface."
" 280, line 9 from the bottom, for "character" *read* "characters."
" 282, line 2, substitute a semi-colon for the colon.
" 282, line 9, for "above" *read* "dorsal side"
" 282, line 4 from the bottom, omit "1887" at the end of the line.
" 283, line 11, for "Lowell" *read* "Lovell."
" 284, lines 22 and 23, for "upper ends of metapleura" *read* "extreme sides of metanotum."
" 289, last line, for "downward" *read* "ventrad."
" 291, line 1, for "IV" *read* "VI."
" 291, line 4 from the bottom, after "posterior," *insert* "border bending."
" 291, last line, for "puelra" *read* "pleura."
" 292, line 11, for "enitrely" *read* "entirely."
" 307, line 6, for "*Head. Male.*" *read* "*Male. Head.*"
" 310, line 3, for "880" *read* "1880."
" 311, lines 1 and 2, for "Mass. Second edition, Cresson" *read* "Mass., second edition; Cresson."
" 312, line 21, for "lower" *read* "ventral."
" 312, line 23, for "above" *read* "dorsal side."
" 314, line 22, for "respected" *read* "rejected."
" 319, line 9 from the bottom, for "1006" *read* "1906."
" 322, line 16, omit "most."
" 322, last line, after "Pacific," *insert* "or Rocky Mountain."
" 326, line 27, for "it is wide" *read* "its width."
" 327, line 19, for "above" *read* "dorsal side."
" 327, line 25, for "either those of" *read* "those of either."
" 328, line 13, after "Franklin," *insert* "*B. edwardsii* Cresson."
" 328, line 13, for "both" *read* "all."
" 329, line 14 from the bottom, after "*yellow*," insert "*or whitish.*"
" 333, line 24, for "ferrugionus" *read* "ferruginous."
" 333, line 29, for "Mantana" *read* "Montana."
" 337, line 2, omit "sharp."
" 338, line 3, place interrogation point after "America."
" 346, line 13, for "rounded" *read* "outcurved."
" 346, line 22, omit "strongly."
" 346, line 23, for "above" *read* "dorsal side."
" 351, line 1, for "piles" *read* "pile."

Page 351, line 18, for "rounded, central" *read* "outcurved; central."
" 351, line 22, replace the colon with a comma.
" 363, next to last line, replace the semi-colon with a comma.
" 366, line 25, for "Thorx" *read* "Thorax."
" 371, line 8, omit "Metlakatla."
" 371, line 9, for "including Vancouver" *read* "Vancouver and Metlakatla."
" 375, line 9, omit "variable."
" 380, line 11 from the bottom, for "in" *read* "on."
" 381, line 24, for "flagella" *read* "flagelli."
" 384, line 15, for "is" *read* "are."
" 384, line 16, omit "most" and for "limit" *read* "limits."
" 384, lines 24 and 25, for "or" *read* "and."
" 388, line 9, for "above" *read* "dorsal side."
" 388, line 11, replace the colon with a comma.
" 388, line 13, for "run" *read* "running."
" 388, line 15, insert "shaft" before "not"
" 403, line 12 from the bottom, for "rounded" *read* "outcurved."
" 405, line 27, insert "about" *after* "are."
" 411, line 11 from the bottom, for "front" *read* "vertex."
" 426, line 14, for "ckeeks" *read* "cheeks."
" 427, line 2, for "argely" *read* "largely."

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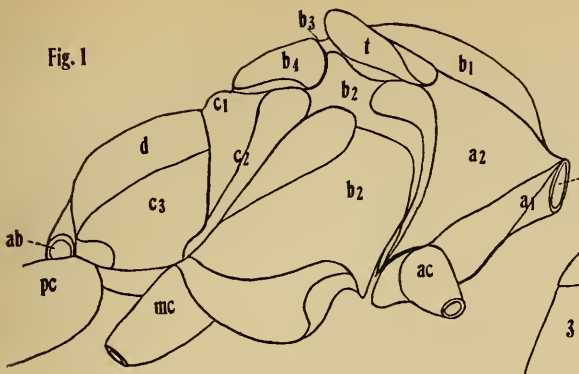

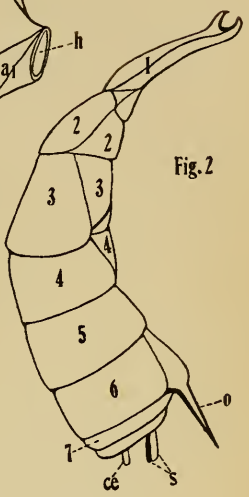

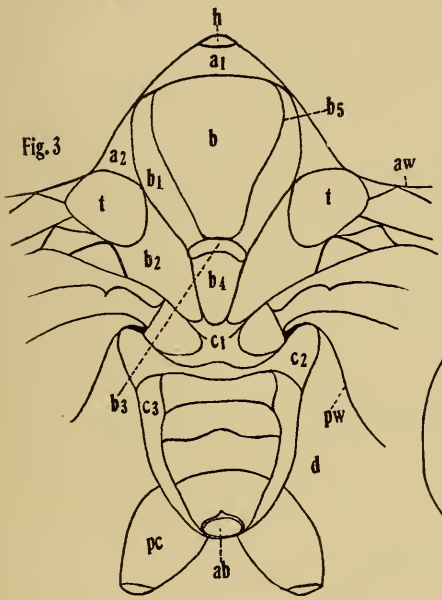

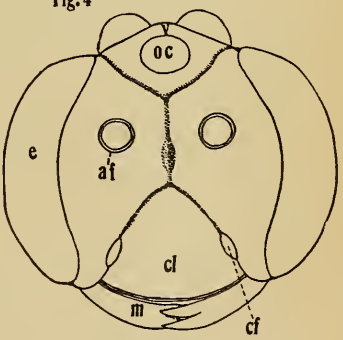

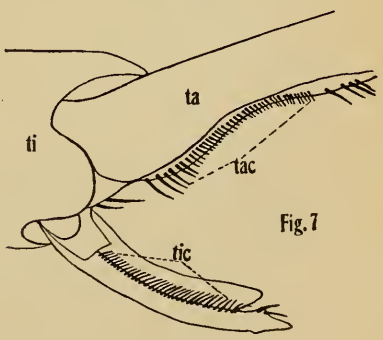

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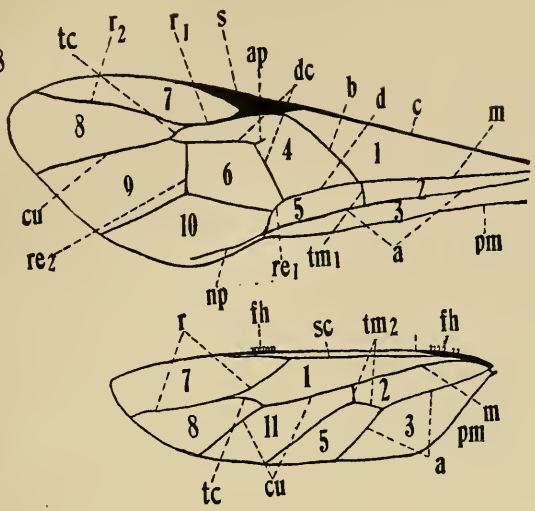

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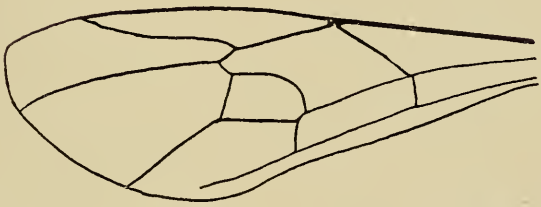

Fig. 10

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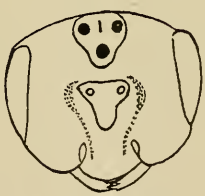

Fig. 12

Fig. 13

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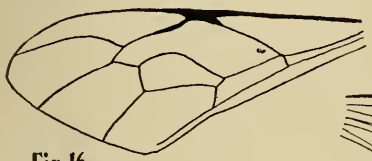

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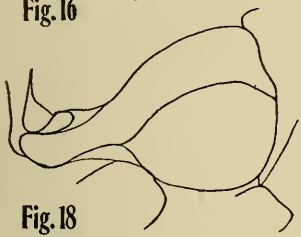

Fig. 18

Fig. 19

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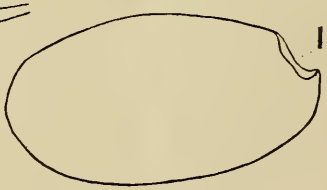

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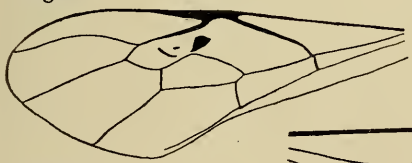

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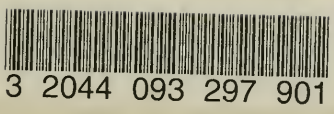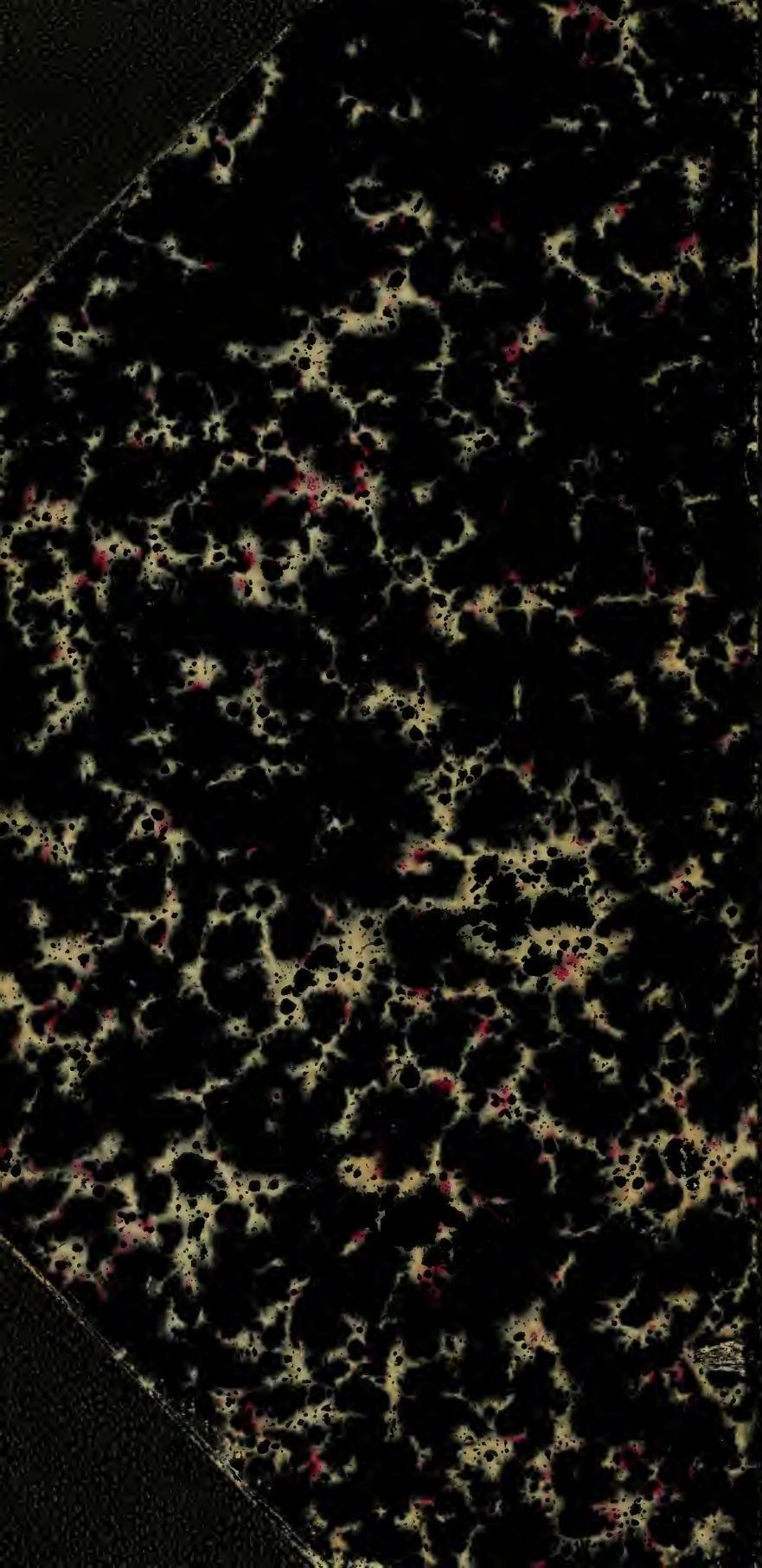
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